EXERCISE-RELATED INJURY PROFILE AMONGST RECRUITS DURING BASIC MILITARY TRAINING IN 3 SOUTH AFRICAN INFANTRY BATTALION AT KIMBERLEY

by

ELÉNE VAN DER WESTHUIZEN

EXERCISE-RELATED INJURY PROFILE AMONGST RECRUITS DURING BASIC MILITARY TRAINING IN 3 SOUTH AFRICAN INFANTRY BATTALION AT KIMBERLEY

by

ELÉNE VAN DER WESTHUIZEN

(2010091441)

Submitted in fulfilment of the requirements

for the degree

Masters in Societatis Scientiae in Nursing

in the

Faculty of Health Sciences

School of Nursing

at the

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS UV

Supervisor: DR. M. REID

July 2013

DECLARATION

I certify that this dissertation, hereby submitted by me, for the MSocSc. Nursing qualification at the University of the Free State is my independent effort and had not previously been submitted for a degree at another University/Faculty. I furthermore waive copyright of the dissertation in favour of the University of the Free State.

_____

E VAN DER WESTHUIZEN

JULY 2013

CERTIFICATE OF EDITING

This certificate serves to confirm that the dissertation done by Eléne van der Westhuizen on “Exercise-related injury profile amongst recruits during basic military training in 3 South African Infantry Battalion at Kimberley” was edited by:

Dr H. Bezuidenhout
Project Manager: Extended Programmes Humanities, UV/UFS
Tel. 051 433 2418 (h) 0724360299 (s)
E-mail: BezuidenhoutH@ufs.ac.za
Date: June 2013

ACKNOWLEDGEMENTS

I am grateful to my family members and friends for their support during the time of my study. I particularly wish to thank my supervisor, Dr Marianne Reid for sharing her expertise, and for guidance and assistance; without you I would not have been able to do this. Lt. Col. J.J. le Roux, thank you for your considerable support and useful comments when I wrote up the study, as well as for being my military advisor during the course of the study. I greatly appreciate the efforts of my field worker, Mrs L. Koekemoer, who handled the arrangements for and provided assistance with the data collection - you made it possible, thank you. I acknowledge the inspiration of The Creator of All Things.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF ACRONYMS

3 SAI Bn	3 South African Infantry Battalion
BMT	Basic Military Training
CT	Computed Tomography
HIV	Human Immunodeficiency Virus
MRI	Magnetic Resonance Imaging
MSD	Military Skills Development
MSDS	Military Skills Development System
NSAID	Non Steroidal Anti-inflammatory Drugs
OHS	Occupational Health and Safety
RPN	Registered Professional Nurse
SANDF	South African National Defence Force

DEDICATION

Nkosi sikelel' iAfrika
Maluphakanyisw' uphondo lwayo,
Yizwa imithandazo yethu,
Nkosi sikelela, thina lusapho lwayo.
Morena boloka setjhaba sa heso,
O fedise dintwa le matshwenyeho,
O se boloke, O se boloke setjhaba sa heso,
Setjhaba sa South Afrika – South Afrika.
by Enoch Sontonga 1897

Photo courtesy of 3 SAI Bn

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION

"Military professionalism, Honour, Patriotism, and Pride" are the values of the South African National Defence Force (SANDF), consisting of three combatant and one support service, namely the Army, Air Force and Navy as well as the Military Health service, acting as a support service. All these services provide employment for permanent and contract personnel. The aim of the SANDF is to defend and protect the borders and people of South Africa and to contribute to a better life for South Africans (Department of Defence 2011:8; South Africa Constitution 1996:122).

An initiative to improve quality of life even further within the South African context was established with the introduction of a two-year Military Skills Development (MSD) programme. The programme was designed to train and develop skills and also to contribute to career opportunities within the SANDF. Applicants from all walks of the South African community undergo a selection process for the MSD programme. Successful applicants, referred to as recruits, commence with an 18-week standardized Basic Military Training programme (BMT) as well as a six weeks' field phase, each year.

The aim of the mandatory BMT programme is to develop endurance and physical fitness, in order to realize the organization's objectives regarding combat readiness for deployments in and outside the country's borders (Van de Venter 2004:12). Recruits are subsequently detached to all four arms of service for further in-service training after successful completion of BMT. The January 2012 intake for BMT was scheduled for approximately one thousand recruits, who would be located at Kimberley and Oudtshoorn.

As in most other countries, the South African BMT consists of intense physical training, drilling, musketry training and a field phase. With the core business of any

defence force being combat readiness, continued and often intensive physical training activity always forms part of daily routines. The programme sequence allows for a progressive increase of activities in order to minimize injuries during BMT (Van de Venter 2004:10). However, exercise-related injuries, such as musculoskeletal injuries and stress fractures still develop during BMT programmes despite efforts to minimise such injuries (Lappe *et al.* 2008:741).

Injured recruits in South Africa report to a military medical clinic for primary health, treatment and care, mostly provided by a Registered Professional Nurse (RPN). Duty restrictions in accordance with injuries are then prescribed while patients who require further interventions are referred for specialist management and treatment to a tertiary facility, often not in the same town.

Since the last study conducted by Jordaan and Schwellnus (1994:421-426) on injuries sustained during basic military training, significant changes in the demographics of the SANDF came about due to the integration and transformation process within the SANDF (South Africa Constitution 2006:122). During BMT in 2010 the Occupational Nursing team in Bloemfontein identified a 32% prevalence rate of pelvic stress fractures, often with tibia, metatarsal, as well as upper extremity injury presentations in recruits. The effects of these injuries varied from pain, loss of training time, morbidity as well as infrequent termination of contracts or permanent disability. Research therefore ought to be directed towards obtaining a better understanding of the existing military population and related injury profile during BMT in order to plan for further health promotion programmes.

1.2 PROBLEM STATEMENT

The negative fall-out of the exercise-related injuries sustained during BMT will persist, due to various effects of *intrinsic and extrinsic* factors and the effect the *training programme* has on the recruits, and especially female recruits, who undergo the same training as male recruits (Constantini *et al.* 2010:799; Hadid *et al.* 2008:229).

Intrinsic factors, considered as risk factors for musculoskeletal injuries during BMT, include aspects such as abnormal high or low body mass, as well as leg length discrepancy and lack of flexibility. Frequent among females are irregular menses, amenorrhea and smoking, possibly causing a decreased oestrogen effect on bone with subsequent low bone density leading to stress fractures (Duran-Stanton and Kirk 2011:53; Maffulli *et al.* 2009:691).

Extrinsic factors are easier modifiable than intrinsic factors and range from utilizing shock absorbing inserts in shoes to modification of weight of gear carried by recruits. Attention to rest and sleeping hours may also contribute to improved bone remodelling, thus preventing further damage to bony structures already under pressure during BMT (Constantini *et al*. 2010:802).

When considering the *training programme* as injury risk factors, limited pre-induction activity, prevailing low level of aerobic fitness and exposure to prolonged running and marching on hard surfaces played a significant role. However, a decrease in injuries was evident with a reduction in route march speed and by positioning shorter recruits in the front and rear of marching squads. This in turn limited the effect of stride length differences between males and females, thus reducing training injuries in females (Hadid *et al.* 2008:329; Moran *et al.* 2008:636).

Research has shown that there are differences in the prevalence of injuries between males and females, with females developing two to three times more injuries than males (Constantini *et al*. 2010:799). Women are required to train alongside men in military settings, regardless of their lower muscle mass, smaller body frame and higher body fat percentage. In addition, they often have less aerobic fitness as well as lower cardiac output and oxygen carrying capacity, which are contributing factors to training injuries (Merkel *et al.* 2008:691).

An additional challenge regarding severe injuries is that they often go unnoticed due to these injuries being overlooked because, rest tends to alleviate pain and speed up the recovery phase (Duran-Stanton and Kirk 2011:55). Apart from a good physical examination, the key factor to a correct diagnosis remains detailed history

taking, along with a high index of suspicion (Duran-Stanton and Kirk 2011:55; Hosey *et al.* 2008:383-384). Frequently motivated military recruits opt to stoically complete BMT, instead of reporting pain or discomfort. This in turn exacerbates the condition and extends the subsequent duration of recovery (Hosey *et al.* 2008:384).

Since the last study conducted by Jordaan and Schwellnus (1994:421-426) on overuse injuries sustained during basic military training, significant changes in the demographics of the SANDF came about due to the integration and transformation process within the SANDF (South Africa Constitution 2006:122). During BMT in 2010, the Occupational Nursing team in Bloemfontein identified a 32% prevalence rate of pelvic stress fractures with furthermore frequent tibia, metatarsal, as well as upper extremity injury presentations of recruits. Effects of these injuries varied from pain, loss of training time, morbidity as well as infrequent termination of contracts or permanent disability. Research therefore ought to be directed towards obtaining a better understanding of the existing military population and related injury profile during BMT in order to adequately plan for further health care needs and health promotion programs. The absence of a recent exercise-related injury profile for recruits undergoing BMT in the South African context indicates that research in the field is required.

1.3 AIM

The aim of the study is to describe the exercise-related injury profile amongst recruits during BMT at 3 South African Infantry Battalion (3 SAI Bn) at Kimberley in order to consider potential nursing care to be provided.

1.4 OBJECTIVES

The identified objectives for the prospective study are to describe the:

- demographic profile of recruits at 3 SAI Bn;
- socio-economic profile of recruits at 3 SAI Bn;
- medical history and injury profile of recruits who sustained exercise-related injuries at 3 SAI Bn; and
- The type and mechanism of exercise-related injuries at 3 SAI Bn.

1.5 RESEARCH PROCESS

The research process is a progressive and accurate decision-making process that aims to find answers to the research problem. These decisions create a so-called “golden thread” that weaves through the study and if proven to be logical may provide evidence of validity and reliability (Botma *et al*. 2010:89). The research process, according to Brink (2006:50) begins and ends with a problem and infrequently comes to conclusive results, however, it forms a spiral creating new matters for exploration. The researcher made use of a research framework that consists of four interactive phases known as the conceptual, empirical, interpretive, and communication phases in order to guide the research process (*cf.* Brink 2006:50).

The conceptual phase is the first phase and is known as the thinking phase, where the basic planning component outlines the proposal, study design and methodology. Second, the *empirical phase* is the doing phase and comprises the literature study, pilot study and data gathering. The third phase is the *interpretive phase* and is concerned with the meaning of evidence accumulated during the study, while the last phase, the *communication phase*, entails the formulation of recommendations (Brink 2006:50-54; Burton *et al*. 2008:60). Figure 1.1 graphically depicts the four phases of the research process as presented in the respective chapters.

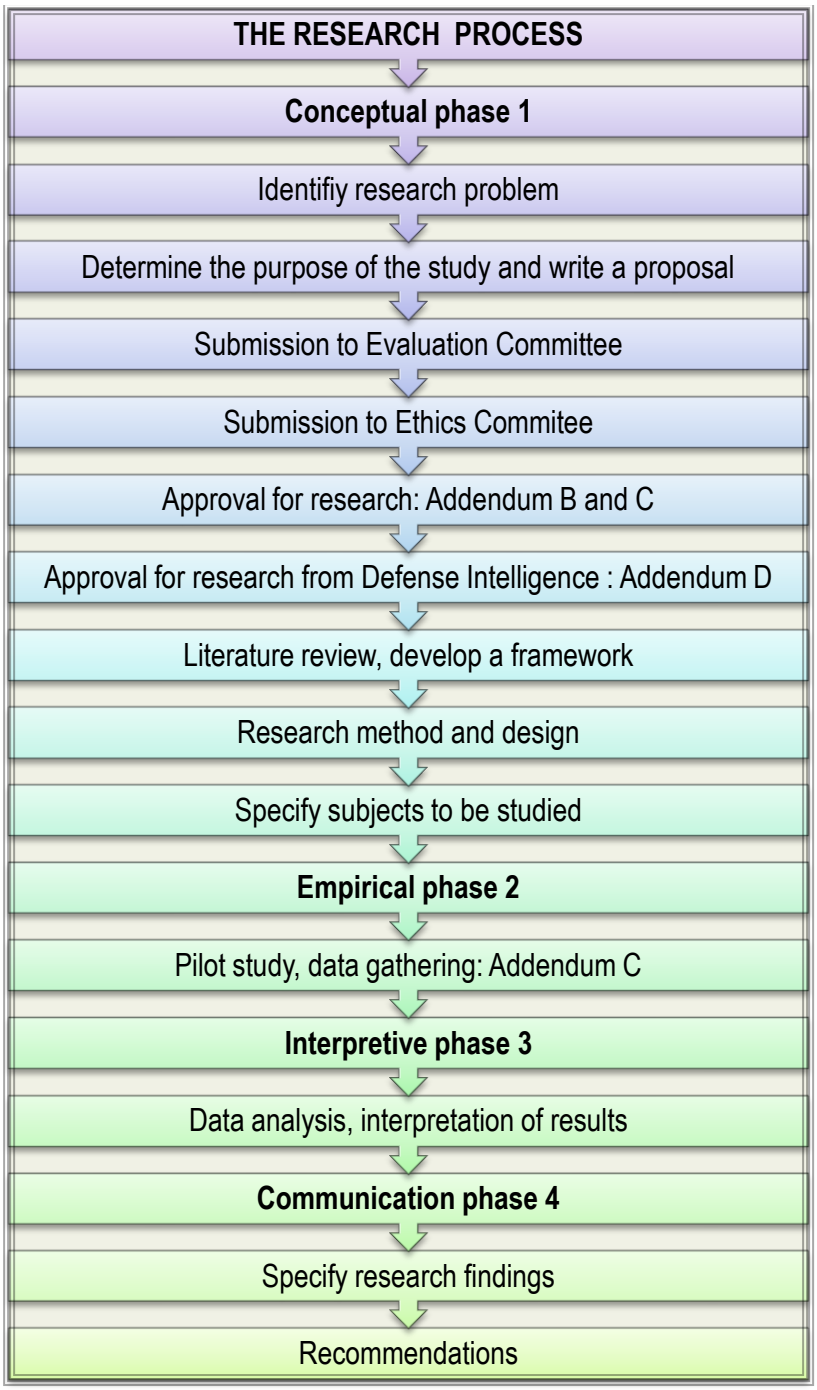


Figure 1.1: The research process divided into four phases (Burton *et al.* 2008:60). Applied to this study.

1.6 CONCEPTUAL FRAMEWORK OF STUDY

A conceptual framework is a visual representation of the relationship between concepts based on existing research and reflects the views of the researcher (Botma *et al*. 2010:283). During BMT military recruits are at risk of suffering exercise-related injuries due to a combination of contributing risk factors, categorized as *extrinsic, intrinsic* and risk factors relating to the *training programme.* This study was aimed at describing the specific influence of aspects forming part of each of the three risk factors identified. The conceptual framework depicted in Figure 1.2 guided the researcher in achieving the study objectives.

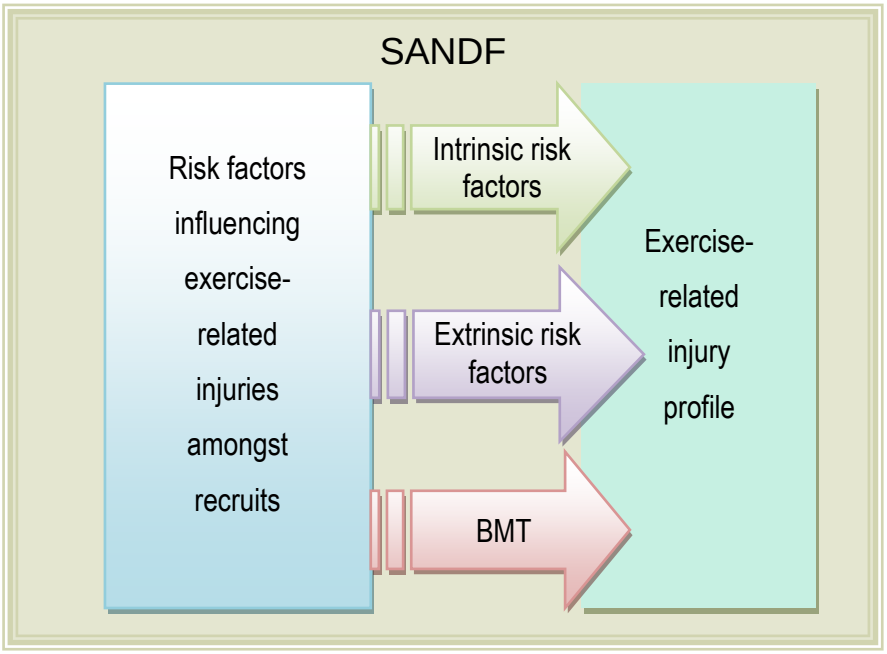


Figure 1.2: Conceptual framework of the study

1.7 CONCEPTUAL AND OPERATIONAL CLARIFICATION

Conceptual clarification is defined by Botma *et al.* (2010:272) as the interpretation of words or concepts supported by sources. An operational definition therefore describes how the variable in the study is measured and observed (Brink 2006:87). The following alphabetically arranged concepts need clarification:

- Basic Military Training

Basic Military Training (BMT) is a 24-week programme consisting of 18 weeks' basic military training and six weeks of a field phase with the aim of developing endurance and physical fitness, in order to realize the organization's objectives regarding combat readiness for deployment inside and outside the country's borders (Van de Venter 2004:12).

- Exercise-related injury

An injury identified in this study has reference to physical conditioning during basic training that is severe enough to interrupt training or normal activity for at least one day (Gordon *et al.* 1986:491).

- Recruit

A recruit is a newly-appointed member in the military that has to go through a basic military training programme before further training and placements can commence in the SANDF (Van de Venter 2004:12).

- Registered Professional Nurse

For the purpose of the study, Registered Professional Nurse (RPN) refers to a registered professional nurse with an additional qualification in clinical nursing science, health assessment, treatment and care. The RPN provides primary health care to the military patient and is registered with the South African Nursing Council in terms of sections 31, 32, 34 of the Nursing Act no 33 of 2005 (Republic of South Africa 2006:6).

1.8 RESEARCH DESIGN

A research design, also known as the blueprint of a study, forms part of the specific purpose of determining the methodology of a study (Brink 2006:92). The intention of using a research design is to gather and analyse data in order to interpret data for results (Brink 2006:102). A quantitative non-experimental descriptive research design explained by Burns and Grove (2011:34, 256) is a formal, precise, and

organized method of determining study criteria and objectives. Efficient communication is made possible by describing detailed events and relationships among variables by means of acquired numerical data. The researcher will therefore utilize a quantitative descriptive research design by using a questionnaire to obtain sufficient numerical data in order to meet the study objectives and to describe and communicate events and injury variables.

1.9 RESEARCH TECHNIQUES

A research technique refers to the method and intend of data gathering (Botma *et al.* 2010:199). The research techniques used in this study comprised a literature based, self-reported questionnaire for the purpose of obtaining relevant demographic, socio-economic and medical data for study purposes. The questionnaire is considered to be a structured instrument with set questions and mostly predetermined responses (Polit and Beck 2008:414) (see Addendum G).

1.10 POPULATION

A population is a total collection of individuals or elements that meet the criteria for research (Tredoux and Durrheim 2010:14). Information in a descriptive design is drawn from a representative and accessible sample of the population (Brink 2006:103,123). The population in this study comprised the January 2012 BMT recruit intake in the SANDF based at 3 SAI Bn at Kimberley. The gender-integrated group undergoes training for a period of 18 weeks and a 6 weeks' field phase. Recruits are divided into five companies, namely Alpha (A), Bravo (B), Charlie (C), Echo (E) and Foxtrot (F).

1.11 SAMPLING

The purpose of sampling described by Botma *et al.* (2010:124-126) is to select a portion of the identified population to represent the available population. The researcher made use of non-probability purposive sampling, thus 378 available

consent-giving recruits from the population of 461 formed part of the sample as they complied with the inclusion criteria for the study.

1.12 PILOT STUDY

A pilot study is a smaller version of the study research technique and focuses on improving the instrument in order to avoid incomplete data-gathering (Polit and Beck, 2008:213). The purpose of a pilot study is to determine whether the prospective participants will understand the requirements, while it may also assist in the assessment of the time required to complete the data collection instrument (Brink 2006:166). A self-reported injury questionnaire was utilized for the purpose of the pilot study. Completeness, clarity and the timeframe to complete the questionnaire were assessed during the pilot study.

Five recruits of 2010, detached to the Military Health Unit where the researcher works, were requested to complete the self-reported injury questionnaire for the purposes of the pilot study. Information obtained during the pilot study only aided in rectifications and was not used for research purposes (*cf.* Botma *et al.* 2010:275).

Permission from the Ethics Committee of the Faculty of Health Sciences of the University of the Free State and of the Chief of Defence Intelligence was forwarded to the Commanding Officer of 3 SAI Bn requesting permission to conduct research. Attached to the formal letter was an example of the information and consent letters together with the questionnaire that would be utilized (see Addendums B, C, D, E, F and G).

1.13 DATA COLLECTION

Botma *et al.* (2010:131) describe data collection as a formal, precise and systematic gathering of data. This process commenced after approval from the Ethics Committee of the Faculty of Health Sciences of the University of the Free State and Defence Intelligence had been gained.

An appointment was made with the identified trained fieldworker as well as the Officer Commanding of 3 SAI Bn in Kimberley, prior to the 18-week BMT programme to discuss the aim and importance of the research. A venue and date for the completion of the questionnaires were identified during this meeting.

Recruits are divided into five companies consisting of up to a total of 120 recruits per company. Each participating company was assigned an alphabet letter and recruits from the same company were allocated an alphanumeric number. Questionnaires, pens and an information sheet together with an invitation to partake in the research were made available to all recruits present, while the trained fieldworker explained the aim, purpose and rights of recruits.

Only recruits interested in completing the questionnaire formed part of the research. These recruits were given a questionnaire to complete up to question number twenty four and if no injuries were reported, they were requested to return the questionnaire to the fieldworker whilst those who reported injuries completed the entire questionnaire.

The trained fieldworker was sensitised regarding interpersonal skills such as being courteous and friendly, so as to create an environment in which the recruits would feel comfortable enough to share personal and medical information. It was also important for the field worker to remain unbiased by respecting the decision of recruits who decided not to participate in the research. Similar information and explanations were given to all four companies in order to obtain objective and reliable information (*cf.* Polit and Beck 2008:429).

Confidentiality of the completed self-reported injury questionnaires was maintained by ensuring limited access to the data by locking away the questionnaires in a safe and secure, steel cabinet (*cf.* Botma *et al.* 2010:18-19). The researcher completed the coding, and the analysis was done by the Department of Biostatistics at the University of the Free State.

1.14 VALIDITY

Tredoux and Durrheim (2010:216) explain validity as a scale that measures what is supposed to be measured. The elements giving meaning to validity are the conclusion that is drawn from what was measured. Chapter 3 creates the opportunity for the researcher to expand on validity measurements in the study.

1.15 RELIABILITY

Reliability, also referred to as a consistency function, reflects the quality of the measurement method. The aim of the measurement method is to obtain the same data each time the data gathering is repeated. Likewise, the same results should also be expected when such an instrument is applied to a similar group, therefore reliability in a study is obtained if a valid measuring instrument is used (Botma *et al.* 2010:177; Babbie 2007:145, 147). A range of literature-based questions were compiled in the self-reported injury questionnaire with the aim of verifying consistency and reliability of the study.

1.16 ETHICAL ISSUES

Ethics relates to issues pertaining to moral aspects about what is right and what is wrong (Cambridge 2008:478). Three ethical issues relating to research on human participants were described in the Belmont Report in which the principles of justice, beneficence and respect for persons were highlighted (Botma *et al*. 2010:3; Brink 2006:131-143).

1.16.1 JUSTICE

Study participants have the right to benefit physically or emotionally and likewise not to be harmed during a study. They should be informed about their rights before the study commences, to afford them the opportunity to withdraw if they so wish (De Vos *et al.* 2011:115). The principle of justice was applied during the study since all

prospective participants were informed about the study by means of an information leaflet containing all relevant information regarding the research and their rights. A telephone number of a contact person also was provided on the consent form that enabled the participants to report a violation of rights (see addendum F) (*cf.* Botma *et al.* 2010:20).

Participants also were protected from unethical behaviour as the researcher is registered with the South African Nursing Council and is therefore subject to all rules and regulations pertaining to registered professional nurses (RPN) (Republic of South Africa 2006:5). The principle of justice also includes the participant's right to fair treatment and the right to privacy (Polit and Beck 2006:90-91).

- Fair treatment

The right to fair treatment endorses impartial behaviour towards participants who refuse to partake and encourages honouring agreements. A researcher should be sensitive to cultural beliefs, habits and lifestyles and should afford participants fair treatment at all times (Polit and Beck 2006:90-91). The five companies were treated in a similar way and no person received preferential treatment. Participants also were given an opportunity to participate or withdraw at any time during the study, without any negative consequences.

Fairness with regard to the use of English as the only language for the information and consent pamphlet as well as the questionnaire was ensured since it is the official language in the SANDF and all recruits had obtained a grade 12 certificate with English as school subject (see Addendums E, F and G). The researcher was not able to identify recruits since the self-reported injury questionnaires identified only numerically and therefore remained anonymous.

- Privacy

Participants have the right to privacy consequently information shared with the researcher must remain undisclosed (Polit and Beck 2006:90-91). Attitudes, behaviour, opinions and medical records are confidential and may therefore not be

shared or used against a participant (Brink 2006:34). The privacy of participants was upheld since data used could not be linked to any specific participant.

1.16.2 BENEFICENCE

Beneficence implies protection from harm, exploitation or discomfort. The aim should be to do good and to minimize harm. The principle is also marked with a risk or benefit ratio. Not only should participants benefit in future from knowledge obtained during the study, but also should benefit on a psychosocial level from the effect and the importance of their participation in the study (Botma *et al.* 2010:3, 20-21). The researcher is not aware of any possible harm or discomfort that participants were exposed to as voluntary; informed consent was obtained from all participants.

1.16.3 RESPECT FOR PERSONS

Respect for persons implies that autonomy is valued and that those with lesser autonomy are protected. The principles of self-determination and protection pertain to full disclosure of research information (Botma *et al.* 2010:3). Participants were respected because their autonomy was upheld by being sensitive towards each participant's right to self-determination, full disclosure, informed consent and confidentiality.

- Self-determination

Self-determination involves the right to autonomy where participants have the right to participate or withdraw without any prejudicial treatment or penalties (Brink 2006:32; Polit and Beck 2008:172). The researcher protected and did not take advantage of diminished rights of participants with lower ranks. Participants were protected from pressure or intimidation; thus, no orders were instituted to enforce co-operation and participation in the study.

- Full disclosure

The researcher explained the responsibilities and the nature of the research, along with essential information concerning the risks, benefits and right to refuse participation. Recruits had the opportunity to ask questions and there was no obligation to disclose or share information, as Polit and Beck (2008:172) explained.

- Informed consent

Informed consent according to Polit and Beck (2006:93) means that the participant is knowledgeable regarding the purpose, expectations, time and cost as well as the benefits and potential risks involved in the study. The participants receive an information leaflet and completed a consent form prior to receiving the self- reported injury questionnaire (see Addendums E and F).

- Confidentiality

No information obtained through the questionnaires may be disclosed with reference to a person's identity or personal information shared. The researcher therefore has the responsibility to secure confidentiality at all times (Botma *et al.* 2010:17). Respondents were identified through their responses since data are depicted for the group and not on an individual basis.

1.17 DATA ANALYSIS

The data analysis was done by the Department of Biostatistics at the University of the Free State. Descriptive statistics, namely frequencies and percentages for categorical data, means and standard deviations or medians and percentiles for continuous data, were calculated per group. The groups were compared by means of 95% confidence intervals.

1.18 CONCLUSION

This chapter introduced the reader to the purpose, aim and objectives of the study. The reader also got the opportunity to visualize the research process to be followed as well as contained the conceptual framework of the study. The proposed research design, technique, how population and sampling would be conducted, as well as how the pilot study and subsequent data collection will help to reach study outcomes. The researcher further eluded to validity and reliability issues as well as ethical issues that would be taken into consideration during the execution of the study. The chapter ended with a concise description of how data analysis would be conducted.

The second chapter will provide a review of the literature pertaining to the study. Details on the methodology and how data were obtained will be discussed in chapter three, while the analysed data will be explained in chapter four. The last chapter will present recommendations based on the findings.

CHAPTER 2: LITERATURE STUDY

2.1 INTRODUCTION

This literature review aims to outline *requirements* for young healthy recruits joining the SANDF as well as providing details on physical demands placed on recruits during *basic military training* (BMT). *Health care* and the role of the registered professional nurse (RPN) in the military are also discussed since the RPN has to *take a history, perform a clinical assessment* and *diagnose* injuries. A profile of possible injuries encountered during BMT, based on the data collection self reported injury questionnaire forms the basis of this chapter. Data reflected include *acute* and *overuse injuries*, *management* as well as *preventative measures* to minimize encountered injuries.

The research processes depicted in Figure 2.1 give an indication on the progress of the conceptual phase while compiling a literature study. The discussion will commence by explaining the recruitment in the SANDF. Figure 2.1 depicts how the researcher has progressed in the research process, here reporting on the literature review that had been conducted with the assistance of a senior librarian at the University of the Free State.

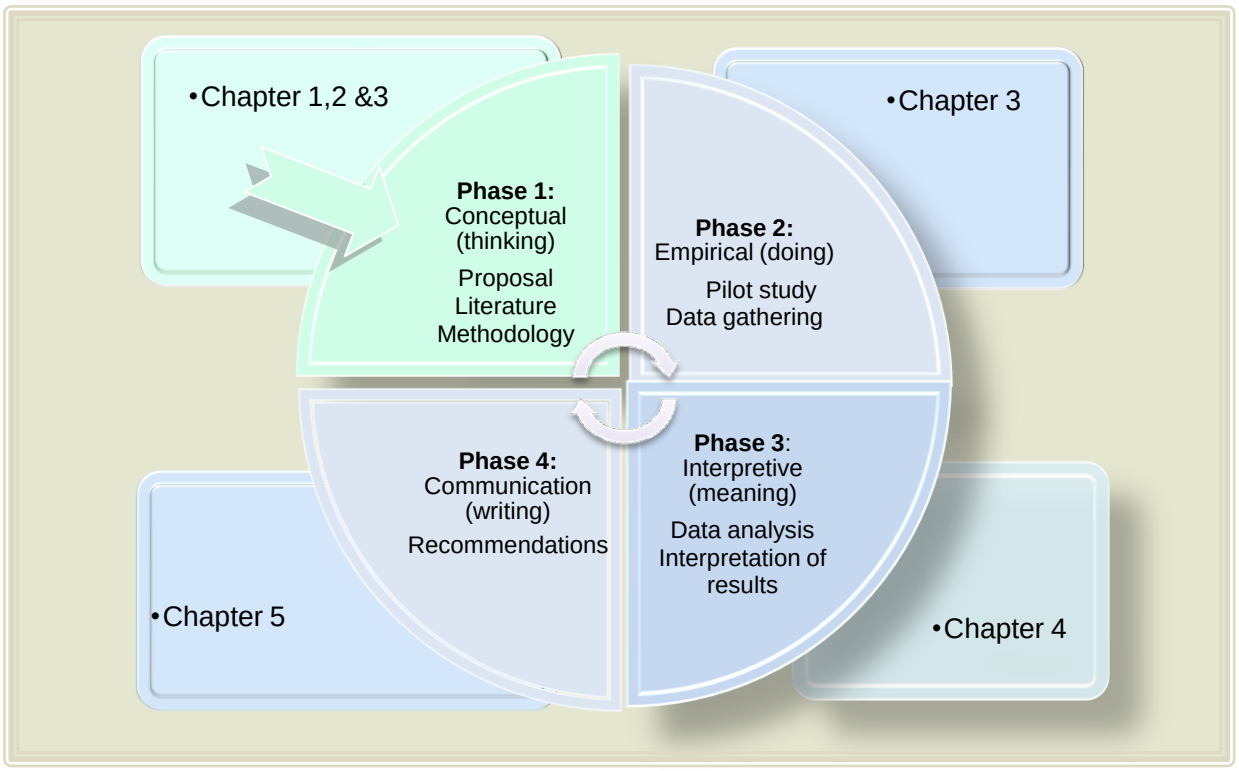


Figure 2.1: The conceptual phase of the research process, currently at literature review (adapted from Burton *et al.* 2008:60).

2.2 RECRUITMENT WITHIN THE SOUTH AFRICAN NATIONAL DEFENCE FORCE (SANDF)

The SANDF has a Regular Force as well as a Reserve Force and both these Forces are in need of soldiers to deploy inside as well as outside the South African borders. As a result, annual recruitment is scheduled to meet the on-going demand for soldiers. These newly recruited, untrained members in the military are known as recruits (Cambridge 2008:1190). However, before appointment in the SANDF all candidates have to undergo a paper–screening selection that includes aspects such as being in possession of a Grade 12 qualification, being of the age group 18-22 years, with a maximum age of 26 years for graduates, and with no serious criminal offences. Candidates are then invited to go through a standardized psychometric evaluation, conducted by psychologists, as well as a comprehensive medical assessment executed by nursing and medical personnel (Department of Defence 2006:B1-B9).

The medical assessment consists of collecting biographical data, medical and surgical history, as well as giving consent for Human Immune-deficiency Virus (HIV) and Hepatitis B rapid blood testing. The medical assessment furthermore entails monitoring of vital signs, height, weight, vision, audiogram, pre- and post-test counselling for rapid HIV and Hepatitis B blood tests, as well as a routine urine test. A pregnancy test in the case of females is performed and if positive during the selection period, the applicant will not be considered for selection until six weeks after giving birth. A positive pregnancy test during the two year Militarily Skills Development System (MSDS) contract, will consequently lead to a discharge from the South African National Defence Force (SANDF) (Department of Defence 2006:8/1-12). Applicants with a history of chronic diseases such as asthma and diabetes mellitus that often require tertiary intervention are not considered for the MSDS due to possible exposure to harsh field conditions, especially during external deployment. Following the above-mentioned data collection, a physical examination is performed by a medical doctor to determine whether further physical abnormalities are present that may require a specialist opinion (Department of Defence 2006:8/1-12). A senior confirming doctor will finally allocate a medical classification for each applicant, indicating the health- and deployability status within the military. All documentation is captured on the Health Informatics System, giving an indication to recruitment role-players regarding the suitability of applicants for utilization within the military (Department of Defence 2006:8A-4).

Successful candidates are consequently required to sign up for the MSDS for a period of two years. Initially all recruits have to go through a BMT programme of 24 weeks, equipping them for military duty (Department of Defence 2006:B1-B9).

2.3. BASIC MILITARY TRAINING

Basic military training (BMT) programmes all over the world have a common goal of turning a healthy but unfit recruit into a fit and combat-ready military soldier. A strenuous and often very intensive fitness training programme is required to meet these training objectives (Brunkner and Khan 2012:943). The aim of BMT is to equip new recruits for utilization within the military environment, and for deployment

for up to twelve months inside or outside South African borders. The BMT programme in South Africa is structured to be executed in a controlled environment, laying a foundation for military skills while fostering a common military culture. Photo 2.1 illustrates how such a military culture is fostered.

Photo 2.1: Instruction on required standard for inspection (courtesy of 3 SAI Bn)

Weeks one and two of BMT start with an orientation, administration, bungalow routine, aspects pertaining to hygiene, mess etiquette and dress regulations as well as rank structure introduction. A normal day during BMT commences at 5 o' clock in the morning, followed by breakfast and roll call. Different drill techniques are practised from 8 o'clock until tea time at 10 o'clock, after which lectures are presented on twenty one different subjects. After a lunch break of 45 minutes, lectures continue until 15:40, followed by physical training for another hour up to supper, with subsequent bungalow routine, maintenance and retraining from 18:30 until 20:30. After a second roll call parade at 22:00 the day is concluded with silence time at 22:15. BMT is considered a high-intensity training programme, allowing

training before and after normal working hours, at night, as well as on Saturdays, if required (Department of Defence 2013:online). Photo 2.2 illustrates activities carried out during day and night.

Photo 2.2: New recruits drilling during day time and undertaking training duties at night (courtesy 3 SAI Bn)

Fitness training forms an essential part of the physical training and is conducted by way of precise physical training schedule guidelines for each day, performed in an incremental and repetitive manner. To be physically fit entails that the recruits meet physical demands for an extended period. Therefore a fitness evaluation includes testing for cardio-respiratory fitness and muscular fitness relating to muscle strength, endurance, flexibility, as well as weight management. Specific objectives of the fitness programme incorporate the improvement of physical performance, health promotion, meeting physical combat demands and handling emergencies and stressful situations (Van de Venter 2004:C2). Various obstacle course activities recruits are to carry out are portrayed in Photo 2.3.

Photo 2.3: Obstacle course training (courtesy of 3 SAI Bn)

BMT is continuously developed and evaluated to improve fitness and limit injuries; however, despite efforts to design excellent programmes, injuries still occur. Therefore, an overview of health care during BMT seems appropriate.

2.4 OVERVIEW OF HEALTH CARE DURING BASIC MILITARY TRAINING

Civilian South Africans are able to utilize public primary healthcare clinics when they are in need of preventative or curative care, even in rural areas. These civilians are most often seen by a RPN that will assess, diagnose and treat patients within her scope of practice. The treatment may include referral to a next level of care, where general practitioners and specialists may complement the patient's care (Dennill and Rendall-Mkosi 2012:5-6; Mash *et al.* 2010:xii). All members of the SANDF are entitled to free health care, provided by a multi-professional team, however, the Primary Health Care Registered Professional Nurse (RPN) in the military, situated at a Primary Health Care setting is often the first of the multi-professional team to be consulted in case of an injury. RPNs within a military setting, who provides care to

recruits, have similar qualifications as civilian RPNs and have the same scope of practice as primary health care nurses within the public health sector in South Africa.

A RPN assisting recruits during BMT, would most often be based in a peripheral military primary health care clinic, with patients then referred to a military or provincial tertiary facility for further medical evaluation or treatment if required. It thus is important for the RPNs to understand their scope of practice and to have *inter alia* a comprehensive knowledge of anatomy and pathological processes. Additionally, they are required to understand, in particular, the intrinsic, extrinsic and biomechanics of injuries in order to treat a recruit holistically.

The intensity of the BMT programme would often be compared to training programmes for professional athletes; however, the differences between the civilian athletic population and military practice manifest in the compulsory nature of physical training within the military. Military recruits undergo exercise regimes to improve fitness and to prepare them physically, but also psychologically in order to cope in extreme environments of discomfort and pain. In most military environments recruits are encouraged to continue exercising regardless of any warning signs of pain, in order to complete goals and to gain the respect of their peers and superiors. By doing so, it is believed to increase the threshold of pain and therefore military populations have higher injury rates in comparison to most civilian athletes. This mind set consequently motivates recruits, while undergoing strenuous physical training, often to seek medical care only when injuries already require longer periods of rehabilitation. It is therefore vital for the RPN to take a good history, perform a clinical assessment, make the correct diagnosis and provide optimal treatment, thereby assisting the recruit to return to the training programme as soon as possible (Brunkner and Khan 2012:8-9, 943; McGraw *et al.* 2012:77).

2.5 HISTORY TAKING, CLINICAL ASSESSMENT, DIAGNOSIS AND TREATMENT

The first step in making a diagnosis when managing a recruit seeking medical care, is to take a medical history, while the physical examination most often determines the appropriate diagnostic investigations. The RPN should furthermore incorporate associated risk factors for injuries such as extrinsic and intrinsic factors and biomechanics contributing to injuries (Brunkner and Khan 2012:8-9, 943; Talley and O'Connor 2010:1). The injury profile of recruits is depicted in Figure 2.2.

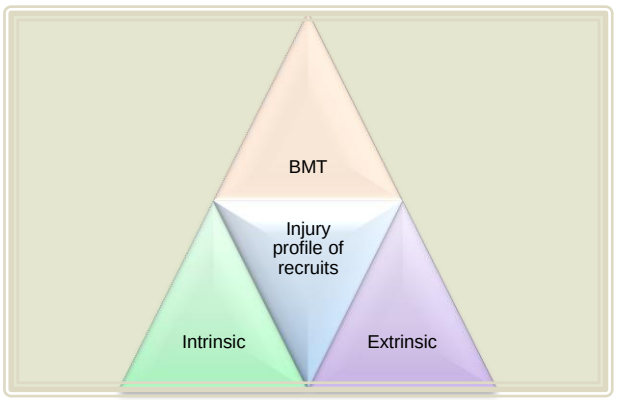


Figure 2.2: Injury profile of recruits integrating intrinsic and extrinsic risk factors during BMT

2.5.1 HISTORY TAKING

The aim of history taking is to obtain information enabling the RPN to establish the anatomical and physiological disturbances, as well as the etiology of the current symptoms. Furthermore, one of the most important decisions would be to determine the patient's ability to continue with the training programme (Talley and O'Connor 2010:3). The skills of history taking and physical examination are still considered to be critical in making a diagnosis, as was also confirmed through studies conducted by evidence-based clinical evaluation, in view of the reality that only limited technological assistance in making diagnoses may be available in a rural primary health setting (Brunkner and Khan 2012:146; Talley and O'Connor 2010:v).

History taking at a first or routine consultation is usually health–orientated and the assessment is comprehensive in nature. In contrast to a follow-up or emergency consultation that tends to have a more focused and flexible combination of disease- or problem-orientated approach (Bickley and Szilagyi 2009:4; Viljoen and Sibiya 2009:vi-2,14). All recruits in this study went through a comprehensive medical assessment prior to BMT, therefore a more disease- or problem-orientated approach is followed throughout the study.

The RPN should follow the three phases in the data-collection process, starting with the introduction while observing the patient. The second phase is the active data-collection phase when facts are collected pertaining to the main complaint. The third phase of data-collection involves the conclusive phase, giving an indication to the recruit of what to expect from the treatment plan. The aim of these phases is to build a relationship of trust with the injured recruit, also allowing enough time during the history taking to obtain conclusive and relevant information regarding the injury (Brunkner and Khan 2012:146; Talley and O'Connor 2010:v; Viljoen and Sibiya 2009:1-2).

Fundamental considerations in taking a history include knowing what type of questions has to be asked to make a differential diagnosis. For that reason the mnemonic, SOCRATES summarizes essential questions that the RPN should ask about the pain or injury:

- **S**ite;
- **O**nset;
- **C**haracter;
- **R**adiation;
- **A**lleviating factors;
- **T**iming;
- **E**xacerbating factors; and
- **S**everity (Talley and O'Connor 2010:3).

It is imperative for the RPN to furthermore take a detailed history about the predisposed factors, in order to prevent further damage. These factors include

extrinsic risk factors, described by Cambridge (2008:498) as factors coming from outside the body, contributing to injuries. Significant contributing extrinsic risk factors include training errors, excessive training volume; rapid increased intensity in the training programme, sudden change in the type of exercise, weight bearing exercises, increased repetitive activities including long periods of drilling, marching and especially running on hard surfaces or wearing inappropriate or worn out shoes at the time of injury (Brunkner and Khan 2012:46; Talley and O'Connor 2010:v). Photo 2.4 shows route marches and musketry training during the field phase which are considered key performance indicators impacting on the entire body due to the terrain and external load carried by recruits.

Photo 2.4: Long distance training on uneven terrain carrying an external load (courtesy of 3 SAI Bn)

General health status inspection also includes inspecting *intrinsic risk factors* related to abnormalities unique to an individual's body, which may also contribute to injuries (Ghani Zadeh Hesar *et al.* 2009:1057). This will be discussed later in the study. The skills of making a diagnosis are based not only on the ability to take a comprehensive history, but also on competency in clinical assessment.

2.5.2 CLINICAL ASSESSMENT, DIAGNOSIS AND TREATMENT

Clinical assessment of a patient requires skills comprising *inspection* and feeling by *palpation*, tapping through *percussion* and listening through *auscultation* (Talley and

O'Connor 2010:xv). Also included are the senses of sight, hearing, smelling and touching (Viljoen and Sibiya 2009:14).

Inspection is a close observation of the injured recruit's appearance, mood, behaviour, movements of facial expression, eye movements, pharyngeal colour, and symmetry of the thorax, and skin conditions. Inspection also includes the gait, height of the jugular venous pulsations, and contour of the abdomen and possible oedema of lower extremities (Bickley and Szilagyi 2009:18). Inspection is part of observation and begins during history taking and continues throughout the examination. Inspection is performed from general to specific observation of size, shape, location, colour, texture and movement of structures. It also includes observation for any swelling, redness, inflammation, muscle wasting or deformity (Mash *et al.* 2010:39).

Inspection of *intrinsic* risk factors related to abnormalities unique to an individual's body includes inspection of posture, co-ordination of extremities, tremors, spasms or any convulsive movement. If the RPN suspects abnormalities, the patient should be requested to walk in a straight line in order to observe the speed, style and ease of movements. This is also done to observe evidence of deformity, asymmetry as well as bruising, swelling, skin changes and muscle wasting. Structural abnormalities and mal-alignment are often associated with susceptibility to sport injuries and include aspects such as pes planus, pes cavus, rearfoot varus, tibia vara, genu valgum, genu varum, patella alta, femoral neck anteversion and tibial torsion. In addition, when body parts are stressed unevenly, for example with leg length discrepancy, greater forces are placed on the knee and hip of the longer leg, causing muscular imbalance and weakness (Brunkner and Khan 2012:149; Ghani Zadeh Hesar *et al.* 2009:1057). Examples of deformities such as pes valgus and pes varus are indicated in Figures 2.3 and 2.4.

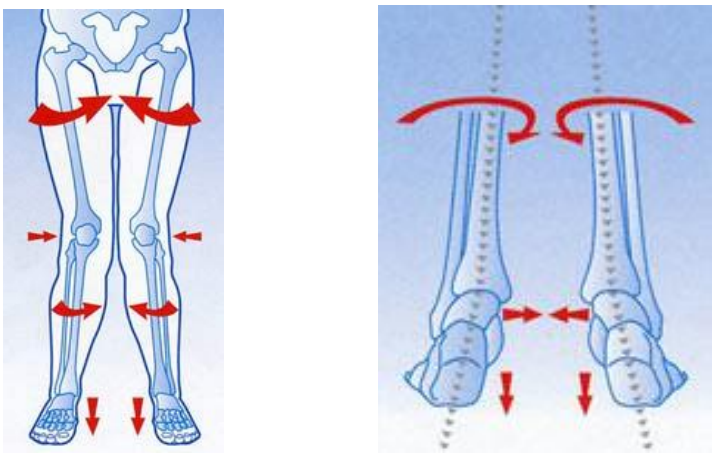


Figure 2.3: Pes valgus affecting lower limbs (Health Posturology n.d:online)

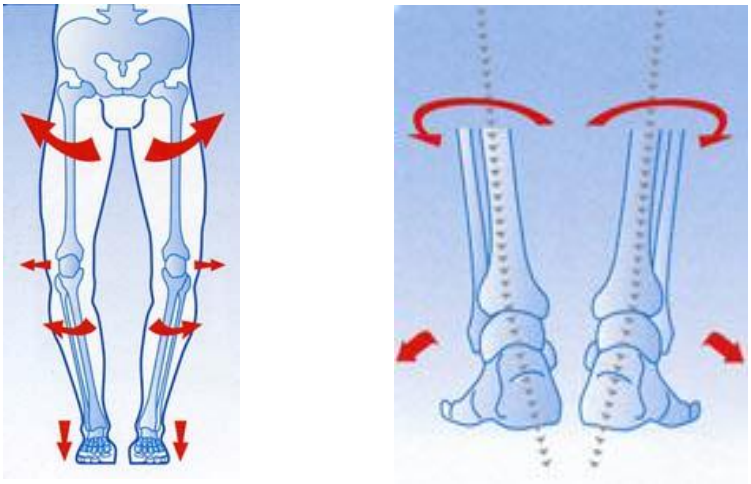


Figure 2.4: Pes varus affecting lower limbs (Health Posturology n.d:online)

These mentioned intrinsic structural abnormalities are known to be contributing risk factors for injuries and should be documented by the RPN as abnormal findings during inspection.

Palpation as described by Bickley and Szilagyi (2009:18) is the application of tactile pressure from the palmar fingers or the finger pads. Performing *light* palpation requires application of pressure by the fingertips of 1-2 cm on the skin to determine tenderness, superficial masses, muscle tone and fluid. *Deep* palpation, on the other hand, entails a palpation depth of 3-5 cm from the body surface. *Ballottement* is also used as a palpation technique where *deep and rapid* palpation is performed with fingers spaced together to determine pressure of masses that are mobile, beneath the abdominal wall. Light ballottement starts low on the abdomen and

movement is performed through quick, light bounding in an upwards direction by the fingertips. Palpation is also performed by utilizing the senses of touch, determining characteristics of tissues and organs (Bickley and Szilagyi 2009:18; Viljoen and Sibiya 2009:33-35).

The RPN should palpate for the presence or absence of the following: tissue swelling, enlargements, pain, stiffness, spasm, crepitations and elasticity. Furthermore he/she also should determine temperature, texture, position, shape, and consistency of the area examined. Patients with a musculo-skeletal injury should be palpated in particular for warmness and soft swelling, possibly associated with inflammation or the collection of fluid within a joint, and tenderness (Mash *et al.* 2010:38).

The RPN should identify the grade of tenderness. Grade i tenderness is confirmed when a patient indicates that pain is present. Grade ii tenderness is substantiated by a wince during examination of a joint, while a patient with grade iii tenderness tends to have winces and withdraws the affected part during palpation. Finally, grade iv tenderness is specified when a patient refuses the examiner to touch the affected joint (Mash *et al.* 2010:38).

In addition the RPN ought to palpate the exact area affected with pain, as well as regions proximal and distal to the pain with the intention of determining focal or diffuse tenderness. The clinical application of tenderness during BMT is to differentiate between stress fractures, where focal tenderness is present and periostitis in the case of diffuse tenderness (Brunkner and Khan 2012:150).

Percussion is performed by a rapid tap or blow against the distal pleximeter finger, mostly the third distal finger of the left hand, while it is laid against the surface of the abdomen or chest. Percussion is used for the purpose of producing a sound wave and vibrations against the pleximeter finger, creating resonant or dull sounds (Bickley and Szilagyi 2009:18). The body surface is lightly tapped during percussion, also involving senses of touch expanding to hearing. Sounds give an indication of density, size, position and shape of organs. In addition, percussion is

helpful in establishing the borders of organs, air or solid matter in the lungs (Viljoen and Sibiya 2009:33-35). Percussion skills are important for the RPN to confirm examination results. The thorax and lungs, as well as the heart and carotid pulses are systematically examined (Brunkner and Khan 2012:150).

Auscultation techniques consist of using the diaphragm and bell of a stethoscope to examine characteristics of the heart, lungs and bowel with detail regarding location, duration, pitch and intensity of the sounds (Marieb and Hoehn 2010:2; Bickley and Szilagyi 2009:18). Auscultation also permits the hearing of the turbulence of arterial vessels, as well as sounds produced by thoracic and abdominal organs or when blood circulates in the cardiovascular system (Viljoen and Sibiya 2009:37). After having discussed the assessment skills, the RPN should physically examine the recruit to identify deviation from normal findings (Viljoen and Sibiya 2009:14).

Finally, the examination includes the spine and extremities for leg length discrepancy, foot types, and the motor nervous system for abnormalities. Ligament testing involves putting stress on the joint by moving it, in order to determine pain and laxity. Application of stress on ligaments resulting in pain will then confirm a diagnosis of laxity of the joint. Muscles should additionally be examined for strength and weakness, as well as comparing opposite sides for muscle weakness and injuries (Brunkner and Khan 2012:150).

Injuries common to recruits are mostly musculoskeletal and therefore require a more focused head to toe screening of the musculoskeletal system (Molloy *et al.* 2012:553). Assessment of recruits with musculoskeletal problems is mostly divided into three groups: first, a complaint of pain or a feeling that something is wrong; second, a patient complaining of limping, weakness and stiffness with impaired movement, and third, noticeable swelling, deformity or a lump. While assessing the injured limb the RPN may notice some abnormality (Mash *et al.* 2010:37). Some of the most common symptoms of musculoskeletal problems are pain, swelling, instability and loss of function, therefore the RPN should first enquire about the characteristics of pain before examining the patient. These are:

- Location;

- onset;
- severity;
- irritability;
- nature of pain - constant or intermittent;
- radiation;
- aggravating factors, for example activity;
- relieving factors;
- associated features - swelling and instability;
- sensory symptoms - pins and needles, and
- motor symptoms - muscle weakness (Brunkner and Khan 2012:146; Mash *et al.* 2010:37).

Assessing a patient with musculoskeletal complaints starts with an initial screening and examination of all or some of the joints by examining both the passive and active range of motion. The RPN should always follow a symmetrical bilateral pattern as well as comparing the examined area to the opposite side of the body (Viljoen and Sibiya 2009:33). Changes possibly due to crepitus, pain or limitation in range of movement should also be documented (Mash *et al.* 2010:37-39). A systematic approach from head-to-toe is followed as depicted in Table 2.1, also known as a cephalocaudal approach (Viljoen and Sibiya 2009:14).

Table 2.1: Screening examination for the musculoskeletal system

SITE OF EXAMINATION	REQUEST THE PATIENT TO:	OBSERVE AND EVALUATE
Temporomandibular joint	Open and close the mouth Move the lower jaw forward.	Range of motion of the Temporomandibular joint
Cervical spine	Turn the head to the right side and then to the left side. Tilt the head to the right and then to the left towards the shoulders.	Lateral flexion and cervical rotation
Shoulders	Fully raise arms in full abduction. Place both hands behind head and elbows pulled fully to the back. Lower both arms and move hands to the shoulder blades on the opposite side internal rotation. To evaluate extension, the hand should be able to touch the opposite scapula.	Glenohumeral, sternoclavicular as well as acromioclavicular movement. In addition also look for asymmetry, trauma and muscle wasting.
Elbows	Bring both arms forward then straighten in front. Bend and then straighten both arms.	Flexion and extension
Wrists	Hold both hands out in front with palms down. Bend hands down and bend hands up. Turn hands over with palms upwards and repeat movement	Malalignment or swelling, flexion, extension and supination
Hands and fingers	Use both hands at the same time by making a fist. Extend and stretch fingers, then touch the thumb with each finger	Flexion and extension. Fine precision, tenderness by gently palpating the meta-carpo-phalangeal joints.
Hips	Raise one foot 15cm from the floor and keep the knee bent. Move the knee out en then in over the midline. Repeat the action with the other leg.	Flexion, abduction and adduction
Knees	Bend first one knee then straighten it. Repeat with the other leg	Swelling or malalignment. Flexion and extension
Ankles and feet	Lift one foot off the floor and bend the ankle upwards. Straighten and stretch the ankle. Turn the sole of the foot inwards and then outwards. Repeat the movement.	Swelling, dorsiflexion and plantar flexion, inversion and eversion
Spine	Stand up and bend forward Attempt to touch the floor	Ability to rise out of the chair; evaluating the spine, hips, knees and ankles. Lumbar spine and hip flexion
Gait	Walk the room distance and return	Symmetry, rhythmic flow .The knee should be extended at the heel strike and flexed at all other phases of the swing. Ability to turn quickly.

Adapted from Mash *et al.* (2010:38)

Subsequent to the more focused head-to-toe screening of the musculo-skeletal system, a discussion follows on the most common injuries that occur during sport participation and therefore will be applicable to the injury profile that the RPN can anticipate during BMT too. Sport injuries occur during any sporting activity, training or an event and can affect a diversity of musculoskeletal structures such as bone, muscle and ligaments (Cambridge 2008:1133).

2.6. INJURY PROFILE DURING BASIC MILITARY TRAINING

An injury, as defined by Finch *et al*. (2011:65) is a body structure or tissue that failed due to transfer of excess energy to a structure or tissue, therefore the injury is fundamentally a biomechanical phenomenon. Studies confirmed that civilian athletes and recruits had similar injuries such as lower leg, hip and groin pain injuries, which may be attributed to the increased intensity, frequency and duration of the training programme (Joy 2007:80).

Commonly associated exercise-related injuries of recruits during BMT were also determined through studies performed in different countries. These injuries have been reported in almost any bone of the body. Mostly affected, once more, were the lower extremities including the tibia and anterior knee, shin, ankle (sprains), foot (pain), as well as tarsal and metatarsal (fractures). Complaints with regard to the abdominal regions included symptoms of groin pain and pelvic stress fractures, as well as lower back and femur injuries. It was also established that one in three recruits presented with these conditions, preventing them from attending training (Itskoviz *et al*. 2011:56-58; Chiet 2009:22; Finestone and Milgrom 2008:623).

Injuries sustained during BMT in the United States seem to be mainly musculoskeletal in nature, affecting approximately 25% of male and 50% of female recruits. These injuries are mainly overuse injuries, accounting for 70% to 80% of musculoskeletal injuries, with the lower limb and lower back being the most prevalent. These exercise-related injuries often have a debilitating effect, requiring medical intervention before recruits can carry on with the training programme

(Molloy *et al*. 2012:553; Constantini *et al.* 2010:803; Hosey *et al*. 2008:385). Studies conducted by Zadpoor and Nikooyan (2011:23) at the United Kingdom Royal Marines, documented an estimated recovery time of recruits with lower extremity injuries, to be 4-8 weeks, with a further period of on average 19 weeks' additional rehabilitative training required, prior to commencing their original training programme.

When looking at BMT in the South African context, a study conducted by Jordaan and Schwellnus (1994:421) confirmed that most injuries were due to overuse (86.4%) while acute injuries accounted for only 13.6%. The majority of these injuries once again were in the lower leg region (80%).

A discussion on the classification of sport injuries will follow in order to give a better understanding of the type of injury a RPN in a primary health setting could expect when dealing with recruits during BMT.

2.7 CLASSIFICATION OF INJURIES

The classification of injuries sustained during sport activities or physical training could either be *acute* or *overuse*, depending on the mechanism and onset of the injury. Overuse injuries are more frequently sustained than acute injuries and are therefore discussed in more detail in 2.7.2. Classification of sporting injuries is done according to *location, type, body side* and the event in which the injury occurred. While affected musculoskeletal structures also include *muscles, ligaments and bones.*

2.7.1 ACUTE SPORTS INJURIES

Acute sports injuries are mostly contributed to *extrinsic* causes such as a sudden direct blow or contact with someone or equipment, along with symptoms of pain and/or an inability to continue with training. Acute sports injuries can affect musculoskeletal structures such as bone, articular cartilage, joint, ligaments,

muscles, tendons, bursae, nerves and skin structures (Brunkner and Khan 2012:15-16; Finch *et al.* 2011:65). Table 2.2 specifies a classification of acute injuries

Table 2.2: **Classifications of acute injuries**

SITE	ACUTE INJURY TYPE
Bone	Fracture and periosteal contusion
Articular cartilage	Chondral fractures and osteochondral fractures
Joint	Dislocation and subluxation
Ligament	Sprain grade: i-iii and tear
Muscle	Strain and tear: grades i-iii, contusion, myositis ossifications, cramp
Tendon	Partial and complete tear
Bursa	Traumatic bursitis
Nerve	Neuropraxia
Skin	Abrasion, laceration and puncture wound

Adapted from Brunkner and Khan (2012:15).

BONE

A *bone fracture* is classified as a simple fracture where bone ends do not protrude through the skin and is therefore called a closed fracture. Compound fractures on the other hand are visible when bone ends protrude through the skin, also known as an open fracture. Pathological fractures occur when the bone is weakened by a disease causing a fracture. Sports fractures mostly occur due to direct or indirect trauma (Waugh and Grant 2010:384). Clinical features to be observed by the RPN are localized bruising, swelling and tenderness, as well as pain during restricted movement and should therefore be referred for further evaluation with possible surgery for displaced fractures. Further complications of fractures could vary from pulmonary and fat embolism or compartment syndrome, deep venous thrombosis, infection or mal-union (Brunkner and Khan 2012:17). The periosteal bone collar is the fleshy formed layer of the bone (Marieb and Hoehn 2010:183). *Periosteal contusion***,** also known as a “hip pointer”, occurs when blood vessels in the outer

layer of the bone are impacted, forming a type of bruise. This injury is rare, although painful, and it is most commonly caused by a direct blow from a stick, kick or ball, damaging the periosteum of the iliac crest. The diagnosis is only confirmed through a magnetic resonance imaging (MRI) and not by means of an x-ray; treatment entails applying ice and resting from training schedules (Quinn 2011:online).

ARTICULAR CARTILAGE

Articular cartilage forms a lining on long bones and provides a gliding area for low friction, which aids in shock absorbing. *Chondral fractures* are traumatic injuries to the articular cartilage and occur during competitive sport participation. The knee is mostly affected, but such injuries could also be associated with soft tissue such as ligament sprains or ruptures. Other areas that may be affected include the talus, patella and humerus. Articular cartilage injuries happen more frequently than was previously realized and are more prevalent than meniscal or ligamentous injuries in skeletally immature patients. *Osteochondral fractures* are also known as articular cartilage injuries; however, here the torn cartilages may also contain fractured bone. Initial x-rays could be normal, but the RPN should have a high index of suspicion of osteochondral fractures in a case where the joint remains painful and swollen for longer than expected. Further diagnostic procedures such as MRI or arthroscopy could be considered for making a correct diagnosis. Treatment of damaged articular cartilage includes passive movement, bone marrow stimulation, joint debridement and surgical drilling, in order to repair structural capacity and function (Brunkner and Khan 2012:17-18).

JOINT

A complete *joint dislocation* occurs during trauma of the articulating surfaces of a joint while *subluxation* takes place in the event of partial contact with the articulating surface. Complications of dislocations are associated with nerve and vascular damage and the RPN should therefore refer all dislocations for x-rays to exclude fractures. Dislocations are normally reduced with the use of injectable muscle relaxants such as diazepam or general aesthetic. The joint capsule and ligaments must be protected and immobilized during and after reduction in order to enhance

healing (Brunkner and Khan 2012:18). The RPN should be aware that repeated injuries may occur later, if joint repair was incomplete (Waugh and Grant 2010:423).

LIGAMENTS

Ligaments are closely packed collagen fibres contributing to passive joint stability. Injuries to ligaments therefore occur when excessive load is placed on the ligament. Injuries range from a mild incident, where only a few fibres are torn, to complete tears of a ligament. Ligament injuries are divided in *sprains* of grade one, two and three. A *Grade i sprain* presents with some stretched fibres while a normal range of motion is still present on stressing the ligament. Grade ii sprains present with proportional fibre damage, while during joint stressing, it shows increased laxity; however, the ligament presents with a definite end point. A grade iii sprain is considered a complete *tear* of the ligament with no firm end point. A complete tear of the ligament could present clinically painful or pain-free due to a complete separation of sensory fibres. Figure 2.5 depicts a normal anterior cruciate ligament and the second picture indicates a complete tear of the anterior cruciate ligament, possibly caused by abnormal rotational or hyperextension of the knee.

Figure 2.5: A normal ligament and complete tear of the anterior cruciate ligament (Lowe n.d:online)

Nursing management of a ligament injury includes minimizing the bleeding and swelling with subsequent referral for further management of electrotherapeutic modalities, joint mobilisation and soft tissue massage for grade one and two

ligament injuries. RPN management of grade iii ligament injuries also starts with first aid management and patients are furthermore referred for possible surgical repair and reconstruction or protective bracing for approximately six weeks. Additional management for all types of ligament injury may include muscle strengthening and proprioceptive training, as well as functional training (Brunkner and Khan 2012:18-20; Waugh and Grant 2010:38).

MUSCLE

Muscle injuries are of the most common sports injuries and account for 10% to 55% of all sports injuries (Brunkner and Khan 2012:19). A *muscle is strained or torn* when some or all of the fibres fail to perform optimally during sudden acceleration or deceleration. Most frequently affected are the hamstrings, quadriceps and gastrocnemius, since two joints are crossed, also known as bi-arthrodial. There are three grades of muscle strain. Grade i present with localized pain with no loss of strength and involves only a few muscle fibres. Grade ii muscle strain involves a *tear* of muscle fibres with localized pain, swelling and limited movement, while the strength of the muscle is reduced. Grade iii strains represent a tea**r** of the muscle, mostly at the musculo-tendinous junction. Healing starts with an inflammatory phase followed by a reparative and remodelling phase (Brunkner and Khan 2012:19-21). Photo 2.5 shows a possible torn hamstring muscle.

Photo 2.5: A strain or tear of the hamstring (Grotewold 2013)

Nursing care of muscle strains includes ice, compression and immobilisation, with subsequently moderate mobilization and gentle massage; however, not within the first 24-48 hours after the injury. Paracetamol remains the analgesic of choice rather

than a non-steroidal anti-inflammatory drug (NSAID). It is essential for the RPN to make an accurate assessment of the severity of the muscle injury, because re-rupture of a muscle accounts for the greatest time lost from sporting activity. An MRI scan and ultrasound are effective in assessing muscle damage in elite athletes, although clinical assessment of the RPN remains the most important evaluation for muscle injury (Brunkner and Khan 2012:19-21).

Muscle contusion relates to damage and bleeding of a muscle and occurs with severe blunt impact or trauma to a muscle. The front thigh in the quadriceps muscle is mostly affected and is known as “cork thigh, charley horse or dead leg”. Management of muscle contusion includes minimizing bleeding and swelling, as well as stretching and strengthening the muscle at a later stage; however, application of heat, alcohol and massage must be avoided, as it will cause an increase in muscle bleeding (Brunkner and Khan 2012:19-21).

Myositis ossifications occur after severe muscle contusion and are considered a complication of a muscle haematoma, due to calcification of the hematoma. A diagnosis can be made through an x-ray or ultrasound after 10-14 days, while management of myositis ossifications remains conservative, with a slow recovery period (Brunkner and Khan 2012:22).

Another muscle condition is *muscle cramps* that present with a sudden involuntary contraction of muscle during or after exercise. Muscle cramps may be temporarily debilitating with the calf most frequently affected. Muscle cramps are also referred to as exercise-related muscle cramping of which the aetiology is still unclear. Consequently RPN treatment of cramps includes passive tension or stretching applied for 20-30 seconds, which may result in symptomatic relief of muscular cramping (Brunkner and Khan 2012:21-22).

TENDON

A tendon consists of tight parallel bundles of collagen fibres. A tendon tear or rupture could be *partial or complete*. A rupture of a tendon occurs without warning and mostly occurs at the point of least blood supply, as well as at the musculo-

tendinous junction. Tendons that rupture are most frequently the Achilles tendon and the Supraspinatus muscle of the shoulder. *Partial tears* have a sudden onset and localized tenderness with pain, while a *complete tear* may sometimes present with an audible pop or snap. Symptoms of a complete tear are pain, tenderness, weakness, and difficulty in using the affected site. The RPN should refer the patient for further management such as an MRI or ultrasound, by means of which a partial or complete tendon rupture can be determined. Acute tendon ruptures require surgery and progressive rehabilitation (Brunkner and Khan 2012:22-23).

BURSA

Bursae are mainly situated between bony surfaces and overlying tendons, and are flat sacs of synovial membrane containing synovial fluid. Bursae are located between tendons and bone; muscle and bone or ligament and bone, thus aiding movement by minimizing friction. An acute *traumatic bursitis* could be associated with a fall onto the bursa causing bleeding into the bursa with acute traumatic bursitis. Nursing management of a bursitis includes application of compression and ice on the affected area. The patient should also be referred to a doctor if the condition persists and management may possibly include aspiration (Brunkner and Khan 2012:23).

NERVE

Nerve injuries, such as injury of the ulnar nerve at the elbow and the peroneal nerve at the neck of the fibula, account for the most often seen injured nerves due to a direct blow during athletics, wrestling, football, hockey or baseball. Activities during BMT are similar and therefore symptoms commonly experienced by patients are a tingling, numbness and pain in the nerve distribution. Pain will persist in the case of more severe injuries, often together with sensory loss as well as weakness or paralysis. The injury is known as *neuropraxia* and could heal spontaneously. The RPN could apply a sling or refer the patient for a cast to support the injured nerve, if the condition persists (Brunkner and Khan 2012:23).

SKIN

Acute skin injuries are well known in sports and often involve underlying structures such as blood vessels, nerves, muscles and tendons, while open wounds are furthermore identified as *puncture wounds, abrasions and lacerations*. Management of skin injuries by the RPN comprise stopping any bleeding and also preventing contamination, often leading to skin infection. Contaminated wounds have the potential of being infected by *Clostridium tetani* and tetanus toxoid should be given as described. Immobilization of the wounded is furthermore encouraged in order to facilitate healing of the wound (Brunkner and Khan 2012:23). Subsequent to the acute injuries discussion, discussion on overuse injuries is required.

2.7.2 OVERUSE INJURIES

Overuse injury results from repetitive micro-trauma to tendons, bones and joints, without any specific traumatic event. Overuse injuries have a gradual onset of inhibition or pain of the injured structure (Havenetidis and Paxinos 2011:1111; Matava 2008:1). Contributing risk factors for overuse injuries include *extrinsic, intrinsic and biomechanical* factors. *Extrinsic* factors refer to aspects influencing the body from outside such as training errors, sudden doubling of training quantity, and worn out shoes, and are therefore more preventable than i*ntrinsic* factors; whereas *intrinsic factors* refer to factors personal to the body, such as body composition, gender, age, leg length discrepancy, as well as malalignment, muscle imbalance, muscle weakness or a lack of flexibility (Brunkner and Khan 2012:16; Finch *et al.* 2011:65; Blacker *et al.* 2008:278).

Biomechanics of human movement relate to the response the human body has when forces and stresses are exerted by and upon it, with gravity possibly being the most relevant force applied to the body, for the reason that almost all movement is set against gravitational pull. When we stand, the centre of gravity lies within the pelvis, in line with the second sacral vertebra, the line of gravity is known as a perpendicular line travelling down through the centre of gravity to the ground. The centre of gravity shifts with different positions, therefore a great deal of muscular stiffening and tension takes place to prevent overbalancing (Endacott, Jevon and

Cooper 2009:573-574). The normal biomechanics of walking also known as the gait cycle, is divided into a stance and swing phase while a full gait cycle is considered from the time that the initial heel strike until the next heel strike of the same foot. The stance phase begins and ends when both feet are on the ground again (Brunkner and Khan 2012:41). A gait cycle is illustrated in Figure 2.6.

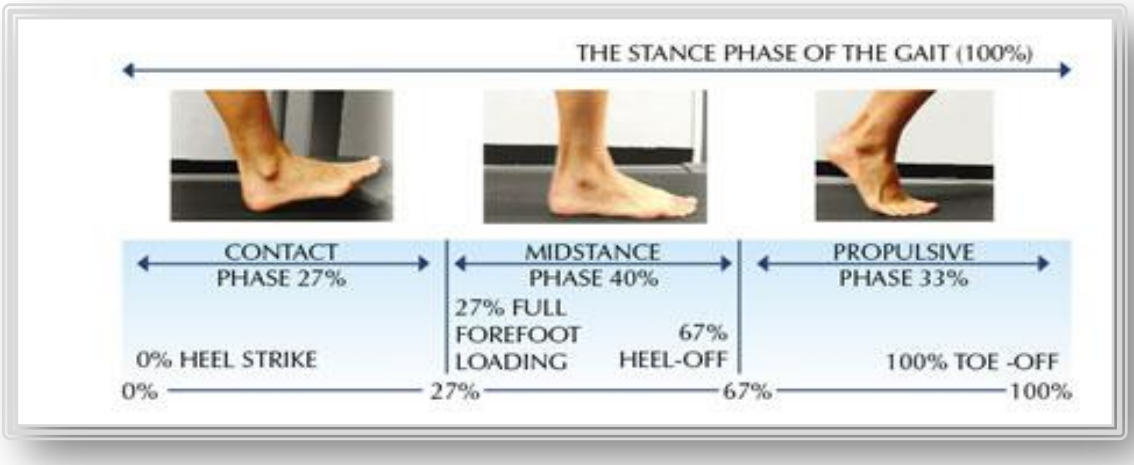


Figure 2.6: The gait cycle (Vasyli medical 2011:online)

Injuries can moreover be contributed to a poor training technique, leading to abnormal biomechanics. Excessive anterior pelvic tilt and lumbar lordosis during running could result in hamstring strain, because of a poor lateral pelvic position, leading to the ilio-tibial band friction syndrome (Brunkner and Khan 2012:61).

When considering lower limb biomechanics, excessive pronation in feet has an inward rolling action after it strikes the ground. This excessive pronation of the foot contributes to a biomechanical factor that causes most foot, leg and hip injuries. However, a degree of pronation is normal and can prevent injuries from occurring by distributing the foot strike force throughout the entire foot (Brunkner and Khan 2012:61).

Excessive pronation in long distance running on the other hand, may cause painful knees, feet and legs, because the ankles are so flexible that the arch of the foot touches the ground, appearing to be due to flat feet. Too little pronation on the other

hand is common in people with rigid ankles and they normally have high arches, absorbing shock well, but they are at increased risk of developing stress fractures in their feet and legs. Studies furthermore determined that the risk factors for gait-related intrinsic factors contributing to the development of lower leg overuse injuries, were directed at the strike of the foot in a less pronated position, that roll off the foot more laterally. Detection of excessive motion and asymmetrical mechanics is important for the RPN who should take note that each individual has his/her their own mechanical structural characteristics and no ideal position should be assumed (Ghani Zadeh Hesar *et al.* 2009:1059).

Diagnoses of overuse injuries entail the taking of a comprehensive history of the onset, nature and site of pain. It is for that reason helpful to ask the patient to perform a painful manoeuvre to simulate the injury, consequently enabling the RPN to identify the anatomical structure involved. Finding potential risk factors and contributing causes of the injury is important in order to prevent recurring injuries (Finch *et al.* 2011:65; Constantini *et al.* 2010:803; Hosey *et al*. 2008:385; Matava 2008:2). Treatment of overuse injuries necessitates attending to activity modification and to promote tissue repair, and furthermore to start with rehabilitative exercises in order to facilitate the repair of damaged tissues. Consider giving pharmacological support such as non-steroidal anti-inflammatory drugs to aid in pain management (Brunkner and Khan 2012:15-16).

Overuse injuries have a widespread, occurrence, especially in running, which accounts for 50-75% of all overuse injuries. Running injuries are defined as pain or injury to a specific area requiring a visit to a health professional or consistent use of medication. Running injuries are caused by the repeated impact of the foot on the ground, exposing structures such as the lower extremities to micro trauma and excessive, repetitive forces especially during marching and running for long periods of time (Finch *et al.* 2011:65). Management of running injuries also necessitates fewer training sessions or changes in the programme, thus limiting the repetitive loading of stress on structures such as the back and lower legs. Classification of overuse injuries affecting different structures as illustrated in Table 2.3 is discussed next.

Table 2.3: **Classification of overuse injuries**

SITE	OVERUSE INJURIES
1. Bone	Osteitis, periostitis, stress reaction, stress fractures
2. Articularcartilage	Chondropathy
3. Joint	Synovitis
4. Ligament	Inflammation
5. Muscle	Muscular fatigue, focal tissue thickening/fibrosis, chronic compartment syndromes
6. Tendon	Tendinopathy
7. Bursa	Bursitis
8. Nerve	Minor nerve injury/irritation, entrapment
9. Skin	Blisters

Adapted from Brunkner and Khan (2012:15)

BONE

Bone is also known as osseous tissue, owing to the rocklike hardness and the ability to protect and support underlying body structures. Bone is harder and more rigid than cartilage, thus able to provide levers for muscles, cavities for synthesis of blood cells, as well as fat storage (Marieb and Hoehn 2010:133). An inflammation of the bone is known as *osteitis,* caused by impact or trauma. Osteitis is characterized by a deep-seated pain and tenderness, most often noted in the symphysis pubis. Osteitis could be caused by bacterial infection, however, both osteitis and periostitis are considered to be primarily caused by overuse (Brunkner and Khan 2012:31).

Pain in the tendinous attachment of the bone is known as *periostitis***,** considered as an abnormal histological appearance of periosteal collagen. Periostitis or tenoperiostitis mainly occurs at the medial border of the tibia and is also known as shin splints. Treatment by the RPN includes symptomatic relief and altering of biomechanics by reducing excessive pronation (Brunkner and Khan 2012:31).

Bone *stress reaction* ranges from bone strain to a more severe reaction such as a stress fracture, also known as fatigue failure injuries of the bone. It is important for the RPN to take note that bony abnormalities, for example tumours and osteomyelitis may also cause abnormalities similar to stress fractures (Brunkner and Khan 2012:16, 25-26).

Stress fractures may occur in any bone in the body and most commonly affected are the *femur, pelvis bones, tibia, and metatarsals* (Brunkner and Khan 2012:16, 25-26). Stress fractures account for 0.7% to 20% of injuries when dealing with sport medicine. Track- and field athletes have the highest rate of stress fractures in comparison to other athletes (Brunkner and Khan 2012:25-26). Zadpoor and Nikooyan (2011:23) reported stress fracture findings during a systematic search of thirteen articles and found that one in three recruits sustained stress fractures during basic training, subsequently also preventing them from attending the training programme. Another study conducted over a 10-year period from 1998 to 2007 utilizing the Israeli Defense Force soldiers database, confirmed that stress fracture prevalence was more common amongst females than males (Itskoviz *et al*. 2011:56). *Stress fractures* are caused by small cracks in the bone after excessive repetitive exercise. Two mechanisms for overload stress are the redistribution of impact forces, causing augmented stress to focal points of the bone, and the action of muscle pulls across bone (Brunkner and Khan 2012:16).

Bone continuously undergoes a breakdown and repair process as it adapts to exposed loads. Bone is thus a dynamic tissue that supports the body in movement and detects mechanical signals of load occurrence, in order to adapt bone architecture to integrate changes (Moran *et al.* 2008:636). Stress fractures characterize the final stages of a range of bone responses to continued biomechanical imbalance, structural fatigue and mechanical damage, resulting in localized tenderness and pain (Chiet 2009:21; Campbell and Fajardo 2008:62). When insufficient time for recovery and remodelling of the bone is allowed, disequilibrium between bone resorption by osteoclasts and the rate of bone generation occurs. The bone therefore weakens and continued repetitive loading

may lead to micro-trauma and the development of partial or complete stress fractures of the bone, with the latter compared with fatigue fractures (Itskoviz *et al*. 2011:56; Maffulli *et al*. 2009:90). Should the initial crack fracture be unable to complete a healing process, while the initial abnormal loading process continues, the accumulated micro-damage then eventually leads to macroscopic damage of the bone, resulting in the presentation of a complete fracture (Beck *et al.* 2008:545; Hosey *et al.* 2008:384).

Furthermore, weight bearing exercises also stimulate, thicken and strengthen the bone by depositing new osteons at the periphery of the bone, through osteoblast action in the inner layer of the periosteum. However, a lack of exercise reverses the thickening process and leads to lighter, weaker bones, increasing the risk of fractures (Waugh and Grant 2010:387).

A clinical nursing diagnosis of a stress fracture is mostly consistent with history taking and physical examination of a patient. Patients present with symptoms such as continued localized tenderness and pain over the fracture site and most patients report a history of change in training activities. Stress fractures could present with acute or subtle onset of pain. Physical examination by the RPN should include the adductor muscle, hip flexors and hip joint during observation, while the patient stands, walks and is positioned in a supine position. Active movements such as hip flexion and extension, hip abduction and adduction, hip internal and external rotation and circumduction tests should be performed. The examination should also include passive movements, resisted movements, palpation, and functional movements such as hopping, in order to reproduce the pain (Hosey *et al*. 2008:384). Treatment of stress fractures is usually conservative and the first step to recovery is to rest and avoid painful activity. The Israeli Defence Force follows an algorithm where recruits with suspected stress fractures initially rest for 10 days, in order to facilitate bone remodelling (Duran-Stanton and Kirk 2011:53-55; Constantini *et al*. 2010:799).

Patients with *femoral neck fractures* complain of hip pain and are often diagnosed with inguinal hernia or an adductor strain, but pain may worsen until patients are

unable to bear weight on lower extremities (Zadpoor and Nikooyan 2011:23). Displacement of a femoral neck fracture requires surgery for further management (Blake and Ross 2008:578).

Symptoms of a *pelvic stress fracture* include chronic pain in the symphysis pubis or in the groin area, which intensifies with running or kicking. Males often complain of abdominal pain, as well as perineal or scrotal pain. A sacral stress fracture presents with a subtle onset of lower back or gluteal pain. Additional areas of pain could include the hip, groin, buttock or thigh regions. Patients then present with a limp while walking, tenderness over the pubic ramus and a normal or limited hip range of motion. In addition, symptoms of tenderness over the sacroiliac joint of the affected side were also reported (Hosey *et al*. 2008:384). Pelvic stress fractures treatment consists of hip muscular strengthening walk to run progression and aquatic therapy (Chiet 2009:22).

A diagnosis of shin splint, also known as *medial tibial stress syndrome*, is distinguished from tibial stress fractures due to tenderness at the length of the posteromedial tibial shaft, with a lack of oedema (Zadpoor and Nikooyan 2011:23). In the medial tibial stress syndrome the pain occurs during exercise, as well as with palpation of the tibia for at least 5cm over the length of the medial tibial surface. This syndrome is caused by a faster bone resorption rate, than the formation of the tibial cortex. A patient with medial tibial stress syndrome will present with pain in the leg, directly related to exercise. The localized pain will be found along the posterior medial border of the tibia (Ghani Zadeh Hesar *et al.* 2009:1059). Treatment of medial tibial stress syndrome includes rest, neoprene or semi-rigid orthotics (Moen *et al.* 2009:524).

Symptoms of *tibial stress fractures* include localized tenderness and pain with percussion, localized pain presenting at night, associated with bone swelling and warmth at the site of the stress fracture (Beck *et al*. 2008:545-547). A non-acute onset of pain aggravated by repetitive weight bearing exercise is often used to make a `diagnosis of lower extremity stress fractures in young marine recruits (Ghani Zadeh Hesar *et al.* 2009:1059; Joy 2007:80). The use of orthotics in lower

limb injuries was evaluated through a novel screening protocol, as a preventative measure, and injuries were significantly reduced (Baxter *et al*. 2011:291). The fulcrum test may aid in diagnosing stress fractures, however, early image studies would be advisable when patients complain of persistent tenderness and pain symptoms, especially during rest (Duran-Stanton and Kirk 2011:55; Hosey *et al*. 2008:383-384). Stress fractures will not show on an X-ray therefore either a bone scan or MRI is needed to see the stress fracture as seen in Figure 2.6.

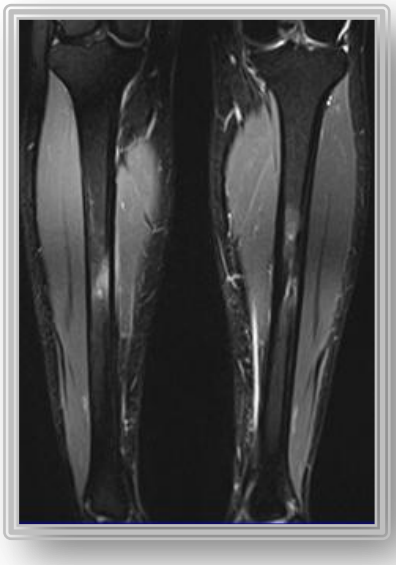


Photo 2.6: Stress fracture of the tibia (Vanderbilt Athletics 2010:online)

The RPN should be cautious when interpreting symptoms, as these symptoms could relate to stress fractures (Moen *et al.* 2009:532). Pain starts with the onset of activities and tends to subside with continued exercise. However, the pain later progresses during activity and eventually even manifests to be present after the activity. Symptoms such as tenderness or oedema after increased activity or repeated activity without sufficient rest are considered important. Differential diagnoses include tendinopathy, compartment syndrome, and nerve or artery entrapment syndrome (Duran-Stanton and Kirk 2011:55; Hosey *et al*. 2008:383-384).

Metatarsal fractures typically present with symptoms of pain on the dorsal lateral aspect of the foot and exacerbate with walking, running and jumping. Duran-Stanton

and Kirk (2011:53) reported that the fractures might take one to two months to heal, depending on the severity. Surgical options are only considered in high-risk locations, non-union or in cases of recurrent stress fractures (Patel *et al*. 2011:39).

A physical examination performed by the RPN may frequently not be conclusive in cases of diagnosis such as stress fractures, nevertheless local tenderness is mostly present and in few cases also periosteal thickening have been visible (Itskoviz *et al*. 2011:56). Diagnostic investigations such as X-ray results may indicate periosteal reaction, although it may be quite normal. A bone scan could show abnormalities; however, MRI studies are increasingly being advised as the investigation of choice when making a stress fracture diagnosis (Moen *et al.* 2009:534).

Most fractures heal within 6-12 weeks while the RPN should continuously monitor the patient's progress in order to allow enough time for recovery (Constantini *et al.* 2010:803; Beck *et al.* 2008:548; Hosey *et al*. 2008:384). Treatment of stress fractures requires avoiding precipitating activities. A good indication for healing of a stress fracture is based on a clinical examination of the non-existence of local tenderness, as well as the capability to carry out precipitating activity without pain. Gradual return to sport is advised to facilitate further healing. Making a correct stress fracture diagnosis in due time could prevent further damage to the patient (Duran-Stanton and Kirk 2011:53-55; Constantini *et al*. 2010:799). Photo 2.7 and 2.8 show plain X-rays of the right foot while Photo 2.9 and 2.10 revealed focal intense activities at the metatarsal indicated by the arrows.

Photo 2.7: "Initial plain radiographs of the right foot (oblique view) revealed sclerosis of the first metatarsal base and sclerosis with cortical thickening of the fourth metatarsal mid diaphysis" (Duran-Stanton and Kirk 2011:54).

Photo 2.8: "Initial plain radiographs of the right foot (lateral view) revealed sclerosis of the first metatarsal base and sclerosis with cortical thickening of the fourth metatarsal mid diaphysis" (Duran-Stanton and Kirk 2011:54).

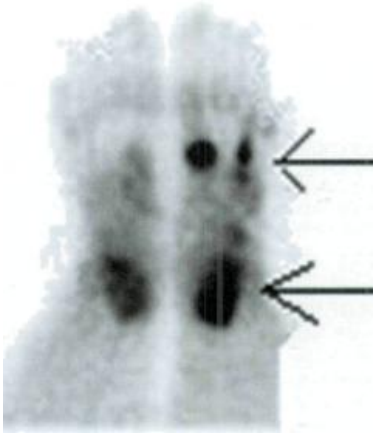


Photo 2.9: "Bone scan revealed presence of focal intense activity at the right first metatarsal base and fourth metatarsal mid diaphysis, which corresponded with the plain radiographs (thin arrows)" Duran-Stanton and Kirk 2011:54).

Photo 2.10: "Bone scan of the right foot (lateral view) revealed presence of a focal intense activities at the first metatarsal base and posterior calcaneus (thin arrows)" Duran-Stanton and Kirk 2011:54).

ARTICULAR CARTILAGE

The anatomical structure and function of the articular structures involve the following: joint capsule and articular cartilage, synovium and synovial fluid, intra-articular ligaments and the juxta-articular bone. The articular cartilage lining can be affected in joints and in particular in osteoarthritis. The RPN should know that injuries to the articular cartilage are characterised by swelling, stiffness and decreased range of motion (Bickley and Szilagyi 2009:573-577).

Articular cartilage injuries also range from microscopic inflammatory to fibrillation, fissuring and then to visible changes such as an overuse injury of the joint. These overuse injuries include diagnoses such as osteoarthritis and patelofemoral

syndrome (Brunkner and Khan 2012:31). Healing of an injured cartilage takes long because of the following: the inability of the cartilage cells to divide, the avascular nature of cartilage resulting in calcification or even ossification in later life, due to chondrocytes not being adequately nourished (Marieb and Hoehn 2010:131).

JOINT

Joint structure and functions include articular and extra-articular structures involving tendons, ligaments, bursae, muscle facia, bone, nerve and overlying skin. There are three types of joint articulation known as synovial, cartilaginous and fibrous articulations, assisting in joint movement. Inflammatory changes to joints are most often associated with overuse injuries and are classified as *synovitis* or capsulitis. Furthermore, examples of overuse injuries are the sinus tarsi syndrome of the subtalar joint, as well as synovitis of the hip joint (Bickley and Szilagyi 2009:573-575).

The RPN should ask the patient during joint pain assessment to point to the pain and enquire about the mechanism and history of injury. In addition, enquire about the type of pain - whether it is localized or diffuse, acute or chronic, inflammatory or non-inflammatory (Bickley and Szilagyi 2009:573-575). The patient should be requested to perform a range of motion exercise without assistance. The RPN must observe any restrictions and onset of pain. Subsequently he/she should examine combined movement for active range of motion testing. Passive range of motion testing is used to determine and elicit muscle and joint stiffness in all directions of movement, in particular to evaluate a joint with normal range of the unaffected side (Brunkner and Khan 2012:149). The RPN should develop a routine by examining the opposite side of injury for control purposes.

Treatment requires referral for biokinetic and orthopaedic assessment and for biomechanic modification, and may in addition require removal of abnormalities to assist in managing the impingement (Brunkner and Khan 2012:31).

LIGAMENT

Ligaments are known to be ropelike bundels of collagen fibrils, connecting bone to bone (Marieb and Hoehn 2010:129; Bickley and Szilagyi 2009:573). Ligament overuse could result in *inflammation*, however is uncommon and is mostly associated with young athletes with immature skeletal structures. More commonly known ligament overuse injuries are those of the elbow which often occur amongst young baseball pitchers (Brunkner and Khan 2012:31). RPN management of ligament injuries also start with first aid management and patients also are referred for possible surgical repair and reconstruction, or protective bracing for approximately six weeks. Additional management for all types of ligament injury may include muscle strengthening, proprioceptive training as well as functional training (Brunkner and Khan 2012:18-20; Waugh and Grant 2010:38).

MUSCLE

Muscle tissues are well-vascularized tissue, responsible for body movement. There are three kinds of muscle tissue, known to be skeletal, smooth, and cardiac muscle. Skeletal muscles are contracted through our conscious control, therefore called voluntary muscles, while the other two types are called involuntary muscles (Marieb and Hoehn 2010:136). Muscle overuse injuries are often attributed to muscle imbalances and can lead to muscle strength and length differences, contributing to poor imbalance, leading to fatigue and muscle injury. *Muscular fatigue* occurs when muscle functioning exceeds the level of adequate supply of oxygen and fuel of molecules such as glucose, therefore leading to decreased muscular response that eventually cease altogether. Muscles require chemical energy called Adenosine triphosphate (ATP) derived from carbohydrate and fat breakdown, while protein may be utilized if fat and carbohydrates supplies are depleted. A subsequent oxygen supply is needed to release energy stored within the fuel molecules. The body utilizes less effective anaerobic metabolic acid production if there is not enough energy stored, leading to lactic acid production causing fatigue from inadequate oxygen supplies during strenuous exercise when lactic acid accumulates. Muscular fatigue occurs with depleted energy stores or due to physical injury to the muscle during strenuous activity (Waugh and Grant, 2010:417).

Focal tissue thickening/fibrosis can be defined as damaged muscle fibres caused by overuse of repetitive micro-trauma to the muscle. The RPN can clinically palpate muscles and will find firm focal areas of tissue thickening. Furthermore findings will also indicate pain in tendons, compromising the inability of the injured muscle to contract and relax. Treatment of minor injuries may include soft tissue therapy, stretching and strengthening of muscles (Brunkner and Khan 2012:32).

Chronic compartment syndrome refers to the elevation of compartment pressure following exercise, while symptoms are mainly associated with pain commencing during activity and being less severe during periods of rest. Inter-compartmental pressure increases during exercise, causing muscle swelling and accumulation of fluids in the interstitial spaces, with impaired blood supply, causing pain. The tight fascia prevents expansion and therefore impairs blood supply causing pain on exertion. The lower legs are usually affected; however, chronic compartment syndrome also occurs in forearms in sports people, such as weightlifters, rock climbers and tennis players. Recruits also take part in casual sporting activities and therefore also encounter similar injuries during BMT. Chronic compartment syndrome is also precipitated by muscle hypertrophy, while acute compartment syndrome is an emergency situation requiring urgent surgical relief. The RPN should refer patients for treatment and this treatment will often consist of initial soft tissue therapy and biomechanical abnormality correction, while surgery is occasionally considered, if therapy is not successful (Brunkner and Khan 2012:33).

TENDON

Tendon overuse injury also known as *tendinopathy* is commonly associated with pain during and after activity. The pain differs and could be only with use of the affected tendon or the pain could disappear while warming up, however sometimes return after cool down period. In the 1980’s tendinopathy was also called tendonitis, but studies found that inflammatory cells were absent. The RPN may find local tenderness or thickening as well as swelling while crepitus may be present with a clinical assessment. Patients should be referred for further management that may include, in more severe cases an ultrasound or even a MRI to determine a partial or

complete tendon rupture. Acute tendon ruptures requires surgery and progressive rehabilitation (Brunkner and Khan 2012:22-23, 35).

BURSA

Bursae are roughly disc-shaped synovial sacs enabling muscles and tendons to glide over each other and are usually situated between the skin and the convex surface of the bone or joint (Bickley and Szilagyi 2009:574). Bursa is also found between bony surfaces with overlying tendons. *Bursitis* is an inflammation of the bursa or small sacs of synovial fluid. Overuse injuries are common at the subacromial bursa, greater trochanteric bursa and retrocalcaneal bursa in combination with tendinopathies and impingement syndromes, mostly due to excessive shearing or compressive forces. The Iliotibialband friction syndrome is frequently seen in cyclists and runners.

Symptoms of pain and swelling are present. RPN treatment remains conservative, involving attention to the inflammation and use of ice. The patient could furthermore be referred and treatment may include electrical stimulation and stretching as well as iontophoresis while NSAID and corticosteroid injections relieve inflammation and thus pain (Brunkner and Khan 2012:37). Hip and groin injuries are frequently attributed to turning, kicking and twisting movements of patients and various structures could be affected, inducing injury to the adductor muscle and tendon, hip joint and associated bursae and muscles. Attempts of the RPN to ignore these symptoms could lead to long-term exercise-related hip and groin pain. Most common causes of pain are strains to the adductor, and less common iliopsoas or hip joint injury. The RPN should also be aware of differential diagnoses in the area such as appendicitis, urinary tract infection, gynaecological pathology, rheumatologic disorders or osteomyelitis (Bickley and Szilagyi 2009:574).

NERVE

A nerve, according to Marieb and Hoehn (2010:491) is described as a cordlike organ forming part of the peripheral nervous system, varying in size. Every nerve consists of parallel bundels of peripheral axons, of which some are myelinated and some are not, enclosed by wrappings of connective tissue. Injuries could involve

structures such as the brachial plexus causing paralysis of upper limbs, for instance, with a limb typically being pulled and the plexus thus stretched, for instance, during contact activity causing a *minor nerve injury or irritation***.** However, in more severe cases compression of the spinal roots of the lumbar plexus could in turn result in gait problems. A patient could sustain an injury to the proximal part of the sciatic nerve after a fall, resulting in various lower limb impairments. The RPN should be aware of symptoms ranging from a stabbing pain radiating over the sciatic nerve distribution to limb weakness. Recovery is mostly incomplete (Marieb and Hoehn 2010:491-510).

Furthermore, *entrapment* syndromes are a result of swelling of surrounding soft tissues or anatomical abnormalities, and the RPN may occasionally refer the patient for possible surgical decompression. Chronic mild irritation of the nerve may cause damage and thus increased neuro-mechanical sensitivity (Brunkner and Khan 2012:37).

SKIN

Skin covers the entire body and accounts for about 7% of body weight, being composed of the epidermis and the underlying dermis. The skin is constantly exposed to trauma, causing *blisters* by separating the epidermal and dermal layers by a fluid-filled pocket (Marieb and Hoehn 2010:149-153). Blisters may occur at any site and may occur due to friction of shoes or equipment. Blisters are painful and can impact on performance, with healing only starting 24 hours post-incident and taking approximately five days to be completed. Skin integrity of athletes is challenged by weather, and some of the most important conditions relating to sport include dermatitis, as well as infections caused by pathogenic organisms. Treatment of skin conditions will be determined by the condition, while patients should be referred to dermatology if unsatisfactory skin conditions persist (Brunkner and Khan 2012:38).

2.8 SPECIAL INVESTIGATIONS

Special investigations such as X-ray examinations, bone scan, magnetic resonance imaging (MRI), computed tomographic (CT) scanning and ultrasound scan may assist the treating health care professional in making a diagnosis. These investigations fall outside the scope of the RPN, but patients might be referred for such investigations.

X-RAY

An X-ray or radiograph is a shadowy negative image of internal structures produced by a directing X-ray (Marieb and Hoehn 2010:18). Plain film radiography provides diagnostic information about bony abnormalities such as fractures, dislocations, dysplasia and calcifications (Brunkner and Khan 2012:158). However, stress fractures, fatigue and insufficiency-type fractures are common, but likely to be underreported, particularly pelvis stress fractures, due to the fact that radiographs are insensitive to stress injuries. Initial radiographs are only 15-35% sensitive to stress fractures, whereas follow-up radiographs are 30-70% positive also see Photo 2.11 and 2.12. Negative radiographs should therefore be repeated after two to three weeks when callus formation may be visible of bone attempting to heal around a stress fracture (Duran-Stanton and Kirk 2011:54; Itskoviz *et al*. 2011:56-58; Chiet 2009:21; Campbell and Fajardo 2008:62). Radiograph imaging in medial tibial stress syndrome is also not reliable due to the fact that callus formation is seldom visible on the medial side of the tibia (Moen *et al*. 2009:534).

Photo 2.11: "X-ray pelvis with both hip joints anteroposterior view showing no abnormality" (Anand *et al*. 2010:458).

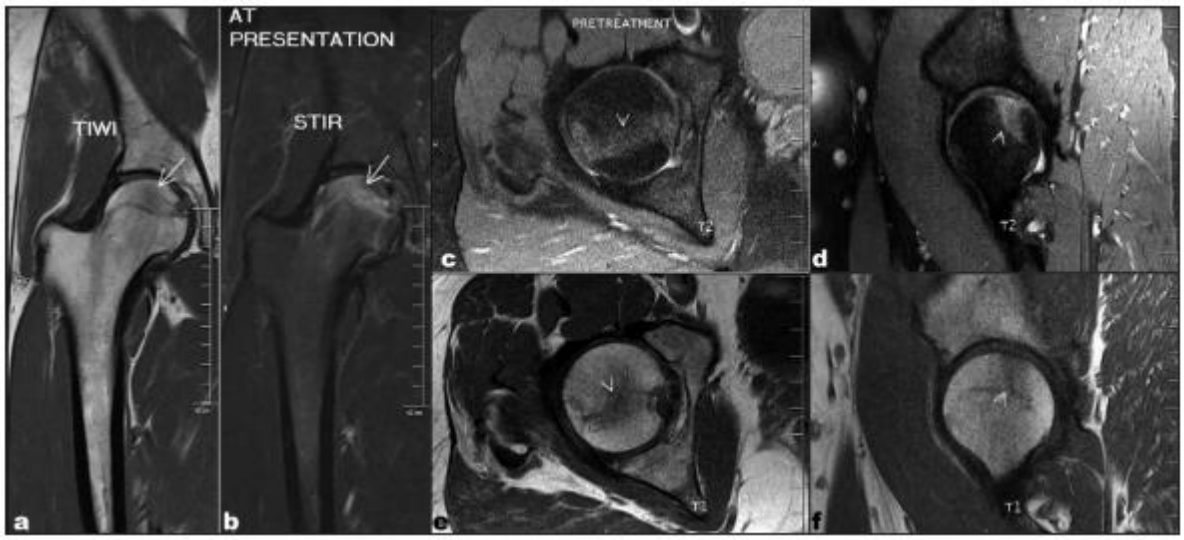


Photo 2.12: "Coronal (a, b) and sagittal (c, d, e, f) magnetic resonance imaging (T-1 and STIR image) showing subchondral marrow edema with a fracture line (marked with arrow and arrow head)" (Anand *et al*. 2010:458).

BONE SCAN

Radio-isotopic bone scan, known as scintigraphy, is highly sensitive and is used to detect increased blood flow, fractures, tumours and bone lesions (Brunkner and Khan 2012:160). A bone scan also shows changes before they are noted on radiographs; even if patients are asymptomatic. An urgent but costly diagnosis can also be confirmed by triple-phase bone scintigraphy with similar sensitivity, but with greater specificity as Magnetic Resonance Imaging (Duran-Stanton and Kirk 2011:54; Itskoviz *et al*. 2011:56-58; Chiet 2009:21; Campbell and Fajardo 2008:62).

MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) delivers high-contrast images of areas not clearly portrayed in an X-ray or computed tomography (CT) such as soft tissue. MRI distinguishes tissues on water content and, for example, can differentiate fatty white matter and more watery grey matter present in the brain (Marieb and Hoehn 2010:19). In addition, an MRI is useful in detecting occult bony abnormalities of the spinal disk, or root abnormalities, avascular necrosis and bone marrow tumours, as well as evaluation of soft tissue masses. An MRI is commonly used to evaluate

internal joint derangement, meniscal pathology and soft tissue injuries especially in tendons, bone marrow and soft tissue; however, MRI can be overly sensitive and thus might provide false positive results in asymptomatic athletes (Brunkner and Khan 2012:159). MRI has increasingly been used during studies of medial tibial stress syndromes as periosteal oedema and bone marrow oedema have been visible and have been determined to be 79% to 88% sensitive, with 33-100% specificity (Moen *et al.* 2009:536).

COMPUTED TOMOGRAPHIC SCANNING

A Computed Tomographic (CT) scanner is a refined version of X-ray equipment. It is a doughnut–shaped CT machine and the X-ray tube rotates around the body. CT scans assist in evaluating aspects relating to the brain and abdomen (Marieb and Hoehn 2010:18). CT scanning is furthermore useful in evaluating the spine, small bone fractures and fractures in complex regions such as the ankle, pelvis or foot, however, a disadvantage of CT scanning is the high radiation dose exposure to the patient (Brunkner and Khan 2012:158). The sensitivity in a computed tomography (CT) scan is lower than an MRI, while it has a higher specificity (Moen *et al.* 2009:536).

ULTRASOUND SCAN

High-resolution ultra sound scans with 10-12 megahertz (MHz) probes are used to image tendons, muscles and soft tissues. Advantages are that it is not painful; no radiation exposure exists, as well as having a short examination time. It can also guide the physician in therapeutic injections under real time. Disadvantages are that the images are less graphic and operator dependent and tissue cannot be penetrated to show deeper structures of the shoulder, hip and menisci. Large tendons such as Achilles, patellar and rotator cuff tendons are most commonly examined through an ultrasound scan (Brunkner and Khan 2012:160; Marieb and Hoehn 2010:18).

2.9 MANAGEMENT OF EXERCISE-RELATED INJURIES

The most important time for the RPN to manage soft tissue injuries is within the first 24 hours following the injury with the purpose of reducing possible bleeding at the site of injury. Almost all sport injuries benefit from immediate *rest, ice, compression and elevation (RICE),* as well as prescribing medication such as *analgesics* and *NSAID* for musculo skeletal and additional considerations in the case of fractures. Patients are furthermore *referred* to relevant multi-disciplinary team role players for further treatment and rehabilitation (Brunkner and Khan 2012:165).

Rest minimizes further damage and limits internal bleeding and swelling, whereas immobilization in the first few days after the injury is important to allow for scared tissue to gain strength and for muscle regeneration. In the case of soft tissue injuries, immobilisation for up to 48 hours is effective in limiting swelling and pain. Nevertheless, prolonged immobilization also has detrimental effects such as stiffness, weakness and muscle atrophy. Complete immobilization, however, is required in the case of acute fractures and stress fractures.

Cryotherapy consists of the application of *ice* on the effected site and is used in the acute inflammatory phase in order to decrease oedema through vasoconstriction and reducing hypoxic injury by lowering metabolic tissue demands. Ice application brings about a localized analgesia effect when skin temperature drops below 15 degrees Celsius. Application of ice reduces pain and causes constriction of blood vessels and limiting inflammation. Ice packs usually are applied for ten minutes and then removed for another ten minutes. These applications can continue for a period of one and a half hours and can be repeated several times during the first 24 hours. Application of an ice massage by means of ice in a polystyrene cup to medial tibial stress syndrome has been indicated to render significant results in decreasing the skin temperature (Brunkner and Khan 2012:166).

In addition, swelling is also limited when an affected area is *compressed and elevated*. Furthermore, referral for rigid braces, taping, air splints, thermoplastic materials; and plaster casts can support immobilization (Brunkner and Khan

2012:166). Application of protective taping or bracing on, for example, an injured knee, will allow enough movement to prevent stiffness and still maintain muscle strength. Continuous passive motion is also part of rehabilitation and could also contribute to enhancing joint healing after orthopaedic procedures (Brunkner and Khan 2012:167).

In the first 72 hours HARM-ful aspect should be avoided at the injury site. These are:

H: Avoid heat and heat rubs such as hot baths, showers and heat packs to prevent subsequent increased bleeding;

A: alcohol decreases muscle strength and could therefore pose a re-injury risk to the patient;

R: running should be avoided to avert further damage; and.

M: massage should be avoided within the first 24 to 48 hours in order to prevent further bleeding and swelling (Brunkner and Khan 2012:166).

Analgesics are prescribed directly after an injury has occurred in order to reduce pain. Some of the most common prescribed analgesics are aspirin, paracetamol and codeine. *Aspirin* has analgesic, antipyretic and anti-inflammatory effects, however, it inhibits platelet aggregation and increase bleeding, and therefore recruits are being advised not to take aspirin. *Paracetamol* has no inflammatory effect and is therefore ineffective for intense pain, but can be used in acute musculoskeletal injuries in doses of up to 3-4g/daily, while *codeine* is considered a more effective analgesic than paracetamol (Brunkner and Khan 2012:168; Hosey *et al.* 2008:385).

Non steroidal anti-inflammatory drugs (NSAIDs) have analgesic, anti-inflammatory and anti-pyretic properties. Most common NSAIDs involve ibuprofen, diclofenac, aspirin or naproxen, but these have an adverse effect on the stomach. Topical agents, more commonly known as sports or heat rubs, lower or increase temperature activation and contributes to the cooling and heating effect. In addition, topical anti-inflammatory agents are effective as a local analgesic; and incorporated examples of NSAID are benzydamine, indomethacin and diclofenac gel.

Corticosteroids drug releasing patches are effective anti-inflammatory drugs that effectively reduce pain and inflammation, while allowing the recruit to continue with the exercise programme; however, the treatment is considered controversial due to its contribution towards delayed tissue healing. Corticosteroids injections administered by a doctor into the injured joint of surrounding tissue may relieve pain and reduce swelling, however, may delay healing, causing an increase in tendon and cartilage damage and if used prior to healing may even further worsen the injury (Brunkner and Khan 2012:170-174). Doctors may consider Alendronate, 70 mg once in 2 weeks, in the case of stress fractures as was given for sub-chondral stress fractures of the femoral head in a study done by Anand and Kodikal (2010:458). Calcium intake has also been effective with fracture healing and bone density subsequent to an injury (Beck *et al.* 2008:548).

Furthermore, patients are *referred* to other role players in the multi-professional team, and advice regarding activity modification is given in order to relieve pain with the help of physiotherapy, ultrasound and electromagnetic field therapy, even though the usefulness of the latter has not been confirmed. Patients can also be referred for further treatment including therapy options such as electrotherapy, manual therapy, acupuncture and dry needling, hyperbaric oxygen therapy or surgery, the use of blood and blood products, as well as extracorporeal shock wave therapy (Brunkner and Khan 2012:166). Non-invasive treatment of extracorporeal shock wave therapy has been used successfully in the treatment of injuries in the case of stress fractures (Moretti *et al*. 2009:1042).

2.10 INJURY PREVENTION

Injury prevention by the RPN starts once the recruit has returned to the training programme. Prevention is categorized in primary, secondary and tertiary phases:

- Primary prevention includes aspects of health promotion and injury prevention, for example wearing ankle guards.
- Secondary prevention includes an early diagnosis and immediate intervention to limit the risk of re-injury.

- Tertiary preventions start when rehabilitation is required to reduce existing disability and disease (Brunkner and Khan 2012:114).

The RPN pre-eminently should be the role-player providing *health promotion* and *preventative* advice and care during consultation, such as detail regarding warming-up, stretching, taping and bracing procedures. An important input would be giving restricted duty recommendations in order to prevent the injured recruit from starting too soon with the training programme. Overuse injuries can be prevented by duty recommendations such as not to wear boots for a period of time or restrictions such as exercise within own ability in high-risk cases. Attention must be given to appropriate training and the planning of adequate recovery phases. Nutrition, as well as psychological health, also plays an important role in the prevention of injuries (Brunkner and Khan 2012:114). The RPN should be able to assess the need for timeous physiotherapy or biokinetics intervention, or the support of an orthopaedic specialist.

Following a systematic injury preventing programme, start with *early diagnosis* and *immediate intervention* while establishing the extent, incidence and severity by recording all injuries. Secondly establishing the etiology and mechanisms of these injuries and thirdly introducing preventative measures in order to limit and prevent such injuries. Additionally, assessing effectiveness of preventative measures by repeating phase one (Brunkner and Khan 2012:132).

Continuous surveillance of injury patterns, as well as factors leading to injuries as in the case of internal risk factors such as age, gender, body composition, health, physical fitness, anatomy alignment and skill level, should be implemented. Exposure to total external risk factors of humans, for example team mates, protective equipment, sports equipment, and the environment is advisable, because an increased risk for injury has been experienced during transitional periods (Brunkner and Khan 2012:21).

RPNs must work in collaboration with physical training instructors in order to plan preventative measures, based on the risk analysis. Aspects to be taken into

consideration are warm-up exercises to prepare the body for exercise, stretching to obtain full range of movement and static stretching for 30-60 seconds to improve flexibility. Furthermore, attention should be given to strapping and bracing when recruits have sustained injuries in order to restrict undesired motion as part of injury prevention, as well as allowing adequate recovery periods (Brunkner and Khan 2012:21). Possible metabolic and nutritional imbalance also has to be ruled out before commencing with a non-weight-bearing exercise programme (Hetsroni and Mann 2009:112).

Faulty training methods should be rectified, such as to terminate the training programme once pain is experienced, as well as to allow sufficient rest periods after route marches. It is also important that the training programme be alternated to stress different parts of the body, as well as to allow time for fibres to be adequately nourished. Recruits should have at least two days between intensive training schedules in order to prevent chronic injury as fibres frequently need more than two days to heal and for glycogen to be replaced between workouts. Therefore, route marches, as well as the implementation of minimum rest and sleeping hours could be considered before the weekend to allow more time for recovery. Studies established that these interventions may not necessarily affect the quality of the subsequent combat readiness and also contribute positively towards health promotion of recruits (Constantini *et al*. 2010:802-803; Hosey *et al*. 2008:385; Warden *et al*. 2007:38).

Rehabilitation involves increasing tissue strength by applying resistance training in order to reduce the effect of forces applied to the body, thus enabling the body to better tolerate the impact of the applied forces (Finch *et al.* 2011:65; Hadid *et al.* 2008:329; Moran *et al*. 2008:636). Stride lengths of recruits during marching increase when the tallest recruits are placed in the front row of a marching squad, determining the pace of shorter recruits at the back; this tend to lead to groin injuries in the latter. As an alternative measure, paying attention to core muscle strength exercises and placing the tallest recruits in the middle with the shorter recruits in the front and back of marching squads will limit the effect of stride length differences between males and females. Moreover, marching for long distances at a

pace of 7,5km/h instead of 5km/h was also found to increase injuries to the lower legs (Finch *et al.* 2011:65; Hadid *et al.* 2008:329; Moran *et al*. 2008:636).

It was found that the modification of weight of gear or weight of load carried by the recruit, reduction in equipment weight, and attention to the centre of gravity on the external load, played a vital role in reducing training injuries (Baxter, Baycroft and Baxter 2011:291). Photo 2.7 displays two examples of weight of gear or weight of load carried. First, a recruit carrying another recruit and second, a recruit having to carry his own back pack as well as the back pack of the female recruit in pain.

Photo 2.13: Recruits assisting one another by carrying external loads (courtesy of 3 SAI Bn)

Various injuries require different kinds of support in order to contribute to the healing process, therefore patients may profit from using crutches and leg braces with lower extremity injuries, whereas in-soles may cushion overloaded feet (Finch *et al.* 2011:65; Hadid *et al.* 2008:329; Moran *et al*. 2008:636). Injuries can be limited by following a gradual fitness programme, as well as a gradual return to fitness

following an injury (Hadid *et al.* 2008:329; Moran *et al*. 2008:636). Considering good biomechanical principles may make the body less prone to injuries, therefore special caution should be taken when moving loads. The RPN should advise instructors on planning each part of the training sequence, to advise recruits to position themselves to be stable and comfortable and to be close to any load carried, as well as not to move out of balance or to twist a body part. Consideration of good biomechanical principles may reduce injuries even though frequently unexpected injuries occur because biomechanical considerations are complex and have limitations to prevent injuries (Endacott, Jevon and Cooper 2009:573-574).

Recovering from an injury is a testing time; however, the support of the medical team, team mates, friends and psychological interventions could also enhance the recovery process (Hetsroni and Mann 2009:112).

2.11 CONCLUSION

The literature review was structured in the sequence of describing recruitment requirements within the SANDF, as well as the physical demands placed on recruits during BMT. An overview was given on health care challenges, clinical assessment and classifications of acute and overuse injuries. Special investigations were considered in order to manage the exercise-relates injuries. Finally, details were given on injury prevention. The next chapter will describe the research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter provided the reader with a literature overview while this chapter will guide the reader through the research methodology by explaining the paradigm and design as well as the research technique that were selected in order to gather appropriate data. Attention will be given to the research population, sampling and performing the pilot study prior to data collection. Fundamental concepts of validity and reliability as well as maintaining ethical standards in order to protect the participant from any harm, are explored. Lastly, the focus will be on outlining the data analysis process. Figure 3.1 provides a graphic representation of the conceptual process of the research design and methodology.

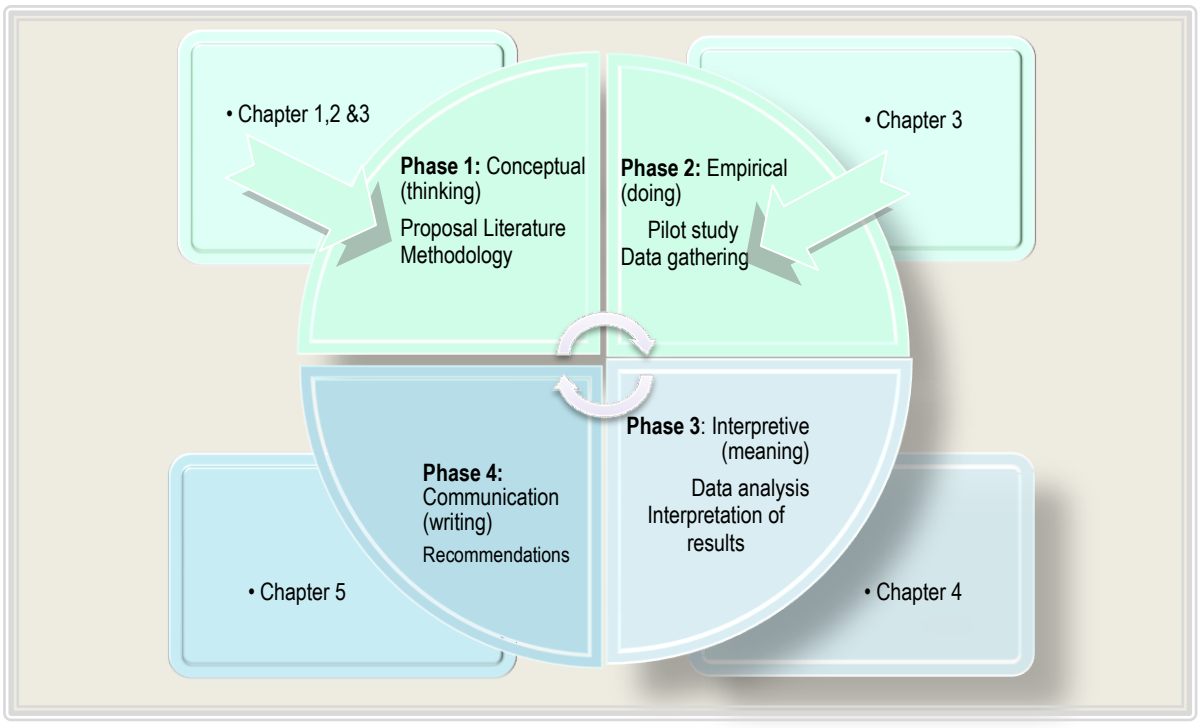


Figure 3.1: Research process in conceptual phase of research method and design (adapted from Burton *et al.* 2008:60)

3.2 RESEARCH PARADIGM

Research is the cornerstone, lifeblood and hallmark of professional development and the importance thereof should be fostered as an integral part of health care practice, education and management (Brink 2006:2). A *paradigm* is a world view or a typical, acceptable way of doing things (Polit and Beck 2012:11; Cambridge 2008:1030). A research paradigm dictates what should be studied and determines what questions have to be asked, how these should be asked and what rules have to be followed in order to interpret the answers that have been acquired from a study. A paradigm also contributes towards attaining consensus in science and differentiates one scientific community from another. Research paradigms are interrelated practices, encompassing systems of thought, defining the nature of an enquiry (De Vos *et al*. 2011:6; Botma *et al. 2*010:40).

There are various ways of doing research and one of the most frequently used ways are the positivistic/scientific paradigms. Positivistic researchers seek generalizations and quantitatively measurable data by means of a scientific approach, also directing research at understanding the underlying causes of a phenomenon (Polit and Beck 2012:11; Burton, Brundrett and Jones 2008:60-61). In this study the researcher followed a positivistic approach, since the quantitative data obtained lend itself towards positivism. There are three philosophical assumptions, namely *ontology, epistemology* and *methodology* (Botma *et al.* 2010:40; Brink 2006:22). A discussion of the first-mentioned philosophical assumption, ontology, follows.

ONTOLOGY

Ontology is the field concerned with the way in which we observe the world and is considered a branch of philosophy, dealing with the nature of reality. It considers the nature and characteristics of the study, as well as all decisions made by the researcher. It is evident from an ontological positivistic approach that reality is not bound by time or context and can be generalized (Polit and Beck 2012:11; Botma *et al.* 2010:40-44, 88). Data obtained from this study could be generalized towards other BMT programmes in the SANDF, with the understanding that injuries would constantly occur during BMT, due to the intensity of the training programme and the

physical, but also psychological and mental impact these injuries have on new soldiers. The second philosophical assumption is epistemology, with the focus on characteristics such as structure of knowledge, rather than content (Botma *et al.* 2010:40).

EPISTEMOLOGY

Epistemology is defined as a branch of philosophy dealing with the nature of knowledge and it provides answers on how we know and clarify matters as well as the relationship between the researcher and the one being research (Polit and Beck 2012:11). Rules are identified by a social phenomenon that determines whether satisfactory justification was given for explanations. Furthermore, epistemological views are objective, rational as well as neutral and in fact separated from society, therefore, it does not have personal values. The emphasis is on empirical research such as quantitative studies, with the prominence on unity of measures (Botma *et al.* 2010:40, 45, 288).

In addition, epistemology describes methods, theories, concept rules and procedures that have to be followed during research. Epistemological questions are systematically described and could be used for large groups of people with knowledge obtained in such a systematic manner, to be considered accurate (Botma *et al.* 2010:40, 45). The epistemological questions in this study are related to the nature of injuries sustained by recruits during BMT. The execution of the research technique, with subsequent data collection and analysis, is meticulously described; therefore findings of this study can be considered accurate and can indeed be generalized to basic military training in the SANDF. The third philosophical assumption is methodology, better known as the method of investigation that through procedures and rules narrates how knowledge should be investigated (Botma *et al.* 2010:41).

METHODOLOGY

Methodology is seen as the belief concerning knowledge and subsistence obtained from values of the framework of philosophy. Statistical analysis and the use of quantitative descriptive studies form part of the positivistic methodological study

type (Botma *et al.* 2010:41, 47, 289; Brink 2006:22). The researcher made use of a quantitative non-experimental research design and applied a questionnaire to obtain knowledge regarding injuries sustained by recruits during BMT. Statistical analysis made it possible to obtain empirically structured, quantifiable measurements, evident in the methodological positivistic approach. A detailed discussion of the research design used now will inform the reader further.

3.3 RESEARCH DESIGN

Polit and Beck (2006:509) define research design as an overall plan to address a research question and indicate specifications for improving study integrity. A research design is considered the backbone of the study since it provides a structure, method and design decisions that allow for effective planning and control over factors interfering with validity of study findings (Burns and Grove 2011:53). A valid research design described by Botma *et al.* (2010:6,108) is one that enhances social value and realizes the aim and objectives of the research, while it is furthermore theoretically correct, with strong evident outcomes that answer the research question. The research question for this study being: “What does the exercise-related injury profile of recruits undergoing BMT in 3 SAI Bn look like?” The researcher followed a quantitative non-experimental descriptive research design to answer the question.

3.3.1 QUANTITATIVE RESEARCH

Polit and Beck (2008:763) explain quantitative research as an investigation of a phenomenon, concerned with precise measurements and quantifications that utilize a controlled design to collect data in a quantified form. Quantitative research has a deductive approach with its roots in positivism, encompassing the idea that reality is ordered and regulated, with studies conducted in an objective and quantified manner. The aim of quantitative research is to test hypotheses and implement an objective systematic approach that explores relationships between variables (Polit

and Beck 2008:763). In this study the researcher had the opportunity to describe the effect of injuries sustained by recruits during BMT.

3.3.2 NON-EXPERIMENTAL RESEARCH

Polit and Beck (2006:505) describe non-experimental research as a study where data is collected without introducing an intervention. In other words no manipulation of an independent variable, nor intervention or controlling a setting applies in a non-experimental design. The study is conducted in a natural environment and a phenomenon is observed as it takes place or exists. Valid study results are essential and the researcher therefore needs to consider variables that would not threaten the validity of a study.

There are two main categories of non-experimental studies illustrated as correlation design and descriptive design (Polit and Beck 2006:52; Brink 2006:102). The study made use of a non-experimental descriptive design, since data were obtained from only one group of people, consisting of all the recruits doing BMT at a specific time and venue. No comparisons were made with another control group (Brink 2006:102). The most frequently used design is the descriptive design and the aim is to describe, explain or explore a situation (Botma *et al.* 2010:110).

3.3.3 DESCRIPTIVE RESEARCH

A descriptive design, as explained by Botma *et al.* (2010:110), is a design used for the purpose of describing a variable as it naturally occurs. It is moreover used in theory development, identification of problems in practices and moderation of current practices, to make judgments, and *inter alia* to determine what other nurses would have done in similar situations (Burns and Grove 2011:56; Barker 2010:69; Melnyk and Fineout-Overholt 2005:256; Muijs 2004:9). The descriptive study was used to describe the injury profile of recruits during BMT.

Descriptive designs, in addition, are used when further information is required about the frequency of an occurrence of a phenomenon. The intent is not to manipulate variables or to observe a cause-effect relationship, but rather to describe variables in order to answer the research question. The emphasis of a descriptive design is on data collection from a representative sample of the population by means of structured observation, questionnaires and interview or survey studies (Brink 2006:102-104). This study made use of a representative sample of the population since 82% of the recruits completed the questionnaire and therefore a reliable reflection of the injury profile could be established through the study. The strengths of a quantitative research design as discussed in the following paragraph, thus made it possible to achieve the study objectives.

3.3 4 STRENGTHS OF QUANTITATIVE RESEARCH

Quantitative research poses advantages for:

- Accumulation of knowledge as well as providing evidence for nursing practice and management (Botma *et al.* 2010:82-83). Knowledge obtained from data on injuries during BMT may aid the RPN in making informed decisions regarding health promotion and prevention programmes for recruits.
- Testing of numbers on the basis of statistical analysis that strives to generalize research results (Botma *et al.* 2010:82-83). RPNs can be taught to be observant and to have a high index of suspicion when managing injuries occurring amongst recruits.
- Providing information from a large number of units (Muijs 2004:9). Three hundred and seventy eight participants provided information by completing self-reported questionnaires.

Quantitative research, however, also has limitations that have to be taken into consideration.

3.3.5 LIMITATIONS OF QUANTITATIVE RESEARCH

Limitations of quantitative researched are that:

- A small number of concepts can be tested and not an entire phenomenon (Botma *et al*. 2010:82-83). Only a small number of data elements had to be tested in the study and therefore have a limited effect on the study results.
- The researcher is not intimately involved in the data gathering process (Botma *et al*. 2010:82-83). The researcher was indirectly involved in data gathering while a trained field worker was directly involved in the process; however, the indirect role of the researcher did not influence data gathering negatively.
- Research content is not interpreted but described (Botma *et al*. 2010:82-83). Objectives set out were able to be addressed in the questionnaire and interpretations were subsequently made possible with the assistance of the Department of Biostatistics of the University of the Free State.
- No exploration of problems or concepts occurred (*cf.* Muijs 2004:9). Analysed data identified problems that could be explored by way of follow-up studies.

The research process is all about making correct decisions. Another essential component of the research process is selecting the most appropriate instrument for data gathering in order to obtain the most significant information relating to the study objectives.

3.4 RESEARCH TECHNIQUE

A research technique is used to gather, analyze and structure information according to a systematic format (Polit and Beck 2008:765). When considering a data collection instrument, Brink (2006:165-166) suggests that the researcher examines factors such as efficiency and appropriateness and the ability to generalize findings. An efficient instrument therefore measures validity and reliability with minimum effort and expense. The instrument should not be too complex or too long to obtain all necessary data (Brink 2006:165-166).

However, appropriateness or suitability in a study indicates the extent to which the research subjects meet the demand of the instrument. The instrument should be appropriate for the purpose and population group for which it is intended and if used previously, changes should be made to ensure that it is also suitable for the current population (Uys and Basson 2005:83-84). The research technique applied in this study was using a literature-based questionnaire, compiled by the researcher, in order to collect research data, specifically applicable to this study.

The content of a research instrument should furthermore be understandable to both the researcher and subjects, along with the appropriate use of language choice that should preferably be in the first language of the participant's choice (Brink 2006:165-166). The questionnaire was compiled in English only, since English is the official language of the SANDF and all participants already obtained a minimum educational level of Grade 12.

3.4.1 QUESTIONNAIRES

Questionnaires are printed, self-reported documents through which participants give written responses. In the questionnaire completion process the respondent, also known as the unit of analysis, writes answers in response to printed questions (Brink 2006:146). The format of the questionnaire used in this study depicts the flowing aspects under the heading of *intrinsic risk factors*: demographic and socio-economic data and medical history. *Extrinsic risk factors* reflect: sport, fitness and injury history. The last section of the questionnaire regarding the *training programme* reflects contributing factors to injuries sustained during BMT (see Addendum G). The structure of the questionnaire assisted the researcher to reach the objectives set for the study. Selecting a questionnaire as a data collection instrument has various strengths.

3.4.2 STRENGTHS OF A QUESTIONNAIRE

Various strengths and advantages of a questionnaire may be summarised as follows:

- Advantages of questionnaires are that a large number of information can be obtained in a quick, economical and standardized manner (Burton *et al.* 2008:74; Opie 2004:94-96). Three hundred and seventy-eight recruits completed the questionnaires within 30 minutes each over a period of three days.
- Questionnaires are written for a specific purpose therefore they can be considered as a reliable and valid data collection method. Questions are offered to participants in a consistent, structured and comparable format, consequently limiting the effect of bias, thereby contributing towards improving the validity and reliability (Burns and Grove 2011:353; Brink 2006:147; Opie 2004:94-96). This was also the case with the questionnaires used in the study, since it was written for a specific purpose and presented to the participants in a consistent format.
- The strength of a questionnaire is dependent on the level of honesty displayed by the participants, clearly enhanced by providing them with optimal privacy and anonymity. A further advantage of a questionnaire is that the subjects are remote and thus not subjected to the mood of the researcher (Brink 2006:147; Opie 2004:94-96). Anonymity could be assured due to the fact that the signature on the consent form could not be linked to the questionnaire. Mostly closed-ended questions were developed in order to comply with the quantitative research design analysis options in the current study. The researcher made use of a trained field worker and therefore was unable to influence participants in any way.

Contrary to the advantage of using questionnaires is a caution of limitations when making use of questionnaires.

3.4.3 LIMITATIONS OF QUESTIONNAIRES

An understanding of the limitations or weaknesses of a questionnaire may sensitize the researcher to take the following into account:

- The response rate is often low when applying questionnaires (Burton *et al.* 2008:74). However, through liaison with the Training Officer at 3 SAI Bn and with the assistance of a trained field worker known to the environment, permission from relevant authorities was obtained in time. Recruits were informed prior to

the completion of the questionnaires and were indeed co-operative when the field worker invited them to participate, therefore positively contributing towards an 82% response rate from the four available companies.

- Questions are short due to response options given for analysis, yet, participants may still leave out some of the items without reason. For this reason, additional work has to be done by the researcher to pilot instructions for clarity and ambiguity. Often a lack of opportunity for respondents to clarify misunderstandings exists, and participants might provide only socially acceptable answers (Burton *et al.* 2008:74; Brink 2006:147). However, being aware of the limitations the researcher aimed to minimize the effects through consultation with various soldiers that recently went through BMT. In addition, multi-professional team members were consulted in order to obtain the most relevant information regarding exercise-related injuries. Piloting was done to clarify instructions and to identify ambiguity in the formulations of questions. The trained field worker was also available to address any uncertainties of participants whilst completing the questionnaire.
- Participant often fail to mark all responses when a questionnaire is too long, consequently incompleteness can also threaten validity of the instrument (Burns and Grove 2011:353). It was not found necessary to condense the questionnaire or items in the questionnaire, as, participants in the pilot study only required between five and fifteen minutes to complete the questionnaire (participants in the study were allowed 30 minutes for completion). No negative feedback was received from participants on the length of the questionnaire.
- An added disadvantage of a questionnaire is that participants have to be literate and are often not representative of the research population (Burton *et al.* 2008:74). However for the purposes of the study, the selection criteria for recruits in the SANDF included a Grade 12 qualification, therefore, complying with the requirements for representativeness, since literacy did not exclude any participant from the study.

3.4.4 IMPLEMENTATION OF THE QUESTIONNAIRE

Selection of an appropriate data collection measurement tool for research is essential for the reason that it has to collect the type of data required for study results (Barker 2010:70-71). A literature-based, self-reported questionnaire was chosen to collect data for the injury profile envisaged as outcome of this study, for the reason that it The questionnaire was structured and participants were given the same opportunity and asked the same questions, namely open or closed-ended questions (*cf.* Hofstee 2006:133).

Study objectives guided the format of the questionnaire while the conceptual framework guided the researcher in formulating the actual questions. The questionnaire consists of three sections: A: *Intrinsic risk factors*, B: *Extrinsic risk factors* and C: *Training programme*. Questions were grouped according to mentioned sections. Figure 3.2 indicates the grouping of questions according to study objectives as well as to which section of the questionnaire the listed questions belong.

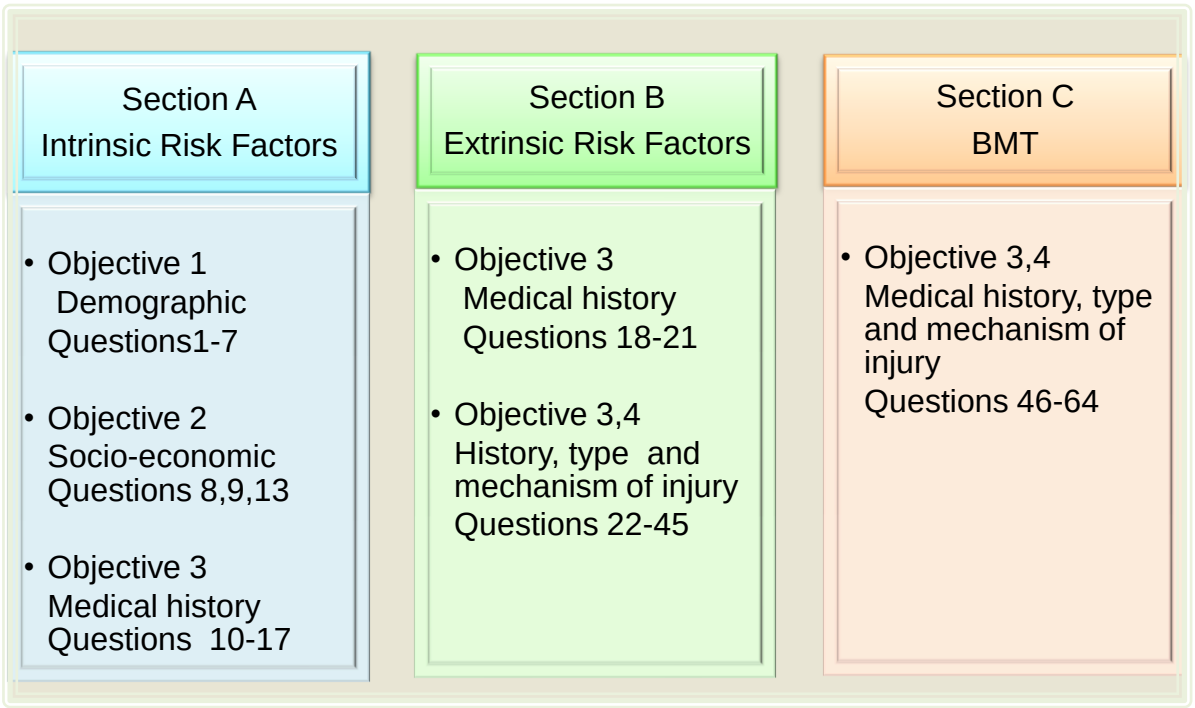


Figure 3.2: Grouping of questions according to study objectives and sections of the questionnaire

Research is meaningful when the contributions made by participants are representative of the research population (Barker 2010:59)

3.5 POPULATION

A population, as described by Barker (2010:59), is an entire group of people who are the focus of the research study. Data are not usually collected from the entire population, often because of limited access to a population group. A target population therefore, is the entire accessible group of people who meet the sampling criteria of the study (Burns and Grove 2011:290; Brink 2006:124). The population in this study consist of the entire 2012 MSD intake in the SANDF, however, 565 recruits enlisted for basic military training at 3 SAI Bn Kimberley formed part of the target population divided into five companies. Characteristics of the population and the distribution of values of the accessible target population were alike, as the group went through similar medical and psychometric testing prior to selection for the programme, and they were enlisted for the same training programme. The BMT programme at 3 South African Infantry Battalion (3 SAI Bn) extended over a period of 18 weeks along with an additional six weeks' field phase. The recruit population consisted of 565 (N=565) recruits divided into five companies. These companies were identified as Alpha (A), Bravo (B), Charlie (C), Echo (E) and Foxtrot (F). An outline of BMT companies and recruit distribution is depicted in Table 3.1.

Table 3.1: BMT population companies also reflecting recruit distribution

BMT Companies	A	B	C	E	F	Total
Recruit Totals	125	105	128	103	104	565

Having decided on the population the researcher had to carefully decide on the approach to pursue sampling.

3.6 SAMPLING

Sampling is a selected segment of a population that takes part in a study and in quantitative research often is referred to as subjects or sampling units (Barker 2010:59). The primary concern of research is mainly to contribute to improvements and therefore large scale analysis has to be performed to come to generalized outcomes. A sample of the population is then drawn to partake in the study. Selecting an appropriate sample is essential, in order to construct generalisable statistical outcomes (Burton *et al.* 2008:46). The researcher utilized a non-probability purposive sampling method for this study. All the available consent-giving recruits completed questionnaires; therefore 378 (82%) participants took part in the study. Table 3.2 reflects the available companies and total recruit participation.

Table 3.2: Available companies reflecting recruit participation

Available Companies	A	B	C	E	TOTAL
Recruit Totals	125	105	128	103	461
Participants from each company	99	104	102	73	378

The empirical phase involves the doing phase, starting once the pilot study has been concluded.

3.7 PILOT STUDY

A pilot study is a preliminary study conducted before the full-scale study is conducted. The purpose of a pilot study, as described by Bell (2010:151) is to remove the “bugs” from the instrument in order to allow respondents in the main study, to complete the questionnaire without any difficulty. A pilot study therefore aids in removing inappropriate items from the instrument.

All data-gathering instruments should be piloted, because it saves time, energy and frustration to participants and the researcher alike. It assists in rectifying various aspects before the main study commences, such as unclear questions or ambiguity, clarity of instructions, wording and format of questions and the reason for leaving questions unanswered. It is advised that the instrument be tried in a group similar to the participant population. Questions should be asked about whether or not the major topic was covered and if any comments should be added. It is not advisable to include participants used in the pilot study to partake in the main research, as they will have become sensitised to the questions (Bell 2010:151; Polit and Beck 2008:380; Opie 2004:104-105). In Table 3.3 the technical aspects and interventions relevant to a data collection instrument are summarised.

Table 3.3: Technical aspects and interventions of a data collection instrument

TECHNICAL ASPECTS	INTERVENTION
Ambiguity and imprecision	Ambiguity and imprecisions were clarified before and after the pilot study.
Assumptions	Assumptions were minimized through expert assistance from other professionals as well as soldiers who recently completed BMT.
Memory	Questionnaire was completed at the end of the basic military training before participants were detached to other units in order to limit recollection loss.
Knowledge	Knowledge obtained from participants was aimed at the educational level of a grade 12.
Have a clear, simple focus	The focus of the study was to understand the injuries suffered during basic military training. The questionnaire was divided into three segments: Segment A: Intrinsic, B: Extrinsic and C: Training programme.
Use familiar language	English is the official language of the military; recruits are therefore familiar with the use of English since their minimum educational level is grade 12.
A range of question types	A variety of questions and options were given to retain attention during completion.
Give instructions when moving to another type of question	Clear, understandable instructions were given to limit misunderstanding.
Thank respondents for participating	Participants were thanked at the end of the questionnaire for their participation and contribution.
The questionnaire must be typed	Participant information such as the leaflet, consent form and questionnaire were typed to permit precise reading.

The researcher consulted with various professionals such as a physiotherapist, biokineticians, an orthopaedic surgeon, medical doctors, a registered professional occupational nurse, as well as soldiers that previously had gone through a BMT, in order to obtain better understanding and to evaluate the relevance and accuracy of questions prior to the pilot study. Ambiguous questions were clarified and questions relating to dress code and terrain were adapted accordingly.

The sequences of questions were grouped according to *intrinsic risk factors, extrinsic* risk *factors* and the *training programme*. The questionnaire was only piloted after all the recommended corrections had been incorporated. The researcher used the platform of the pilot study to ensure that the questionnaire would comply with the technical aspects of using a questionnaire. Suggestion of technical aspects was formulated in Table 3.3 proposed by Bell (2010:119,141); Burton *et al.* (2008:93-94) and Opie (2004:96).

3.7.1 TESTING OF DATA COLLECTION QUESTIONNAIRE

The revised literature-based questionnaire was pre-tested by five participants from the 2011 BMT programme, currently working at a Health Centre within the SANDF. They were informed about the research through an information leaflet (see addendum E) and were requested to take part in a pilot study. A questionnaire was provided to each participant enabling them to participate. The purpose was to determine the time it would take to administer the instrument and it was found that it took participants between 10 and 15 minutes to complete for most of those who had not sustained serious injuries. Overall the questionnaire was understandable; however, misunderstandings about the question relating to the back pack were rectified.

The researcher ought to verify wording and request advice from an analysis adviser before data-collection (Bell 2010:52,121). Therefore, after corrections had been made, the questionnaire was submitted to the Department of Biostatistics at the University of the Free State for evaluation prior to data collection.

3.8 DATA COLLECTION PLAN

The data gathering plan is a way of collecting data and in quantitative research should be systematic, precise, accurate, valid and have meaning, while it furthermore has to be effective to achieve the research purpose (Botma *et al.* 2010:131; Polit and Beck 2008:374). Steps of data collection are specific to each study and are dependent on the technique and design of the study. The researcher specifies the exact sequence of how, where and when data collection will be executed (Burns and Grove 2011:361). The aim of data collection in the study was to obtain information by means of a questionnaire on the exercise-related injuries amongst recruits during basic military training at 3 SAI Bn at Kimberley.

The researcher followed guidelines specified by Polit and Beck (2008:376-377) to describe the data collection plan. Data collection started once the research need had been identified and approved by the Ethics Committee of the Faculty of Health Sciences of the University of the Free State, and copies of the proposal, questionnaire and proof of approval were sent to Defence Intelligence and a Military Ethics Committee to obtain further approval to conduct the study within the DOD.

An appointment was made with the 3 SAI Bn Training Officer in Kimberley in February 2012, in order to discuss the prospective research. A civilian RPN was recruited as a field worker. The role of the field worker was important for the study, because it limited the exposure of participants to military attitude and influence.

The field worker was trained with regard to deviations in the data collection process and was aware of the importance of interpersonal skills such as being courteous and friendly and to create an environment in which the recruits felt comfortable enough to share personal and medical information. She was aware of ethical aspects such as voluntary participation and that there would be no penalties for those who choose to withdraw from the study. A caution was also extended to the field worker that female recruits neglected to complete all information in the female only questions, during the pilot study.

Understanding the data needs and to take steps to obtain all information within the limitations of resources and time, are very important to achieve end results (Polit and Beck 2008:376-377). Consequently, aspects that had to be considered were to obtain administrative information about the venue and dates to conduct research. A communal hall within 3 SAI Bn was obtained, because it is well known, accessible and equipped with chairs and tables, and it was suitable for the completion of questionnaires. A time and date were determined by the field worker and the training officer to obtain data from participants.

An invitation to participate in the research was given to recruits by the field worker by means of an information leaflet, as well as a consent form that explained the aim and purpose of the research, while the rights of the recruits were also included in the document. Recruits of the five companies were informed by the field worker about the scheduled time and arrangements for the completion of the questionnaire in the hall at 3 SAI Bn.

An information leaflet was read to all participants and they were then given an opportunity to give consent by signing a consent letter that contained all relevant research information (see Addendum F). Questionnaires were distributed to all participants of which each company was assigned an alphabetic number and recruits from the same company were thus allocated this particular alphanumeric number. Recruits who did not sustain any injury also completed the questionnaire up to question 24 and handed it to the field worker after completion. For the purposes of the study an interrupted duty of one day was described as an injury and participants subsequently received a questionnaire for each injury sustained. All questionnaires were collected by the field worker and no unauthorised people had access to this information. Photo 3.1 depicts participant completing questionnaires.

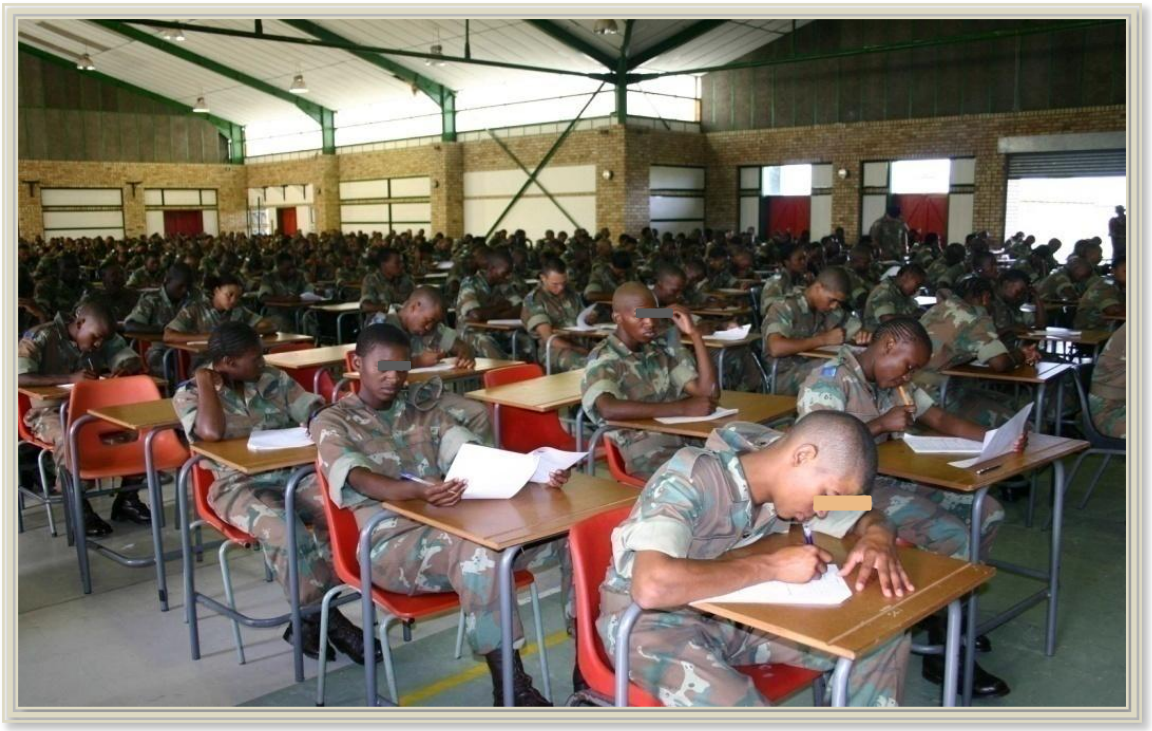


Photo 3.1: Participants completing questionnaires

The field worker was unbiased by accepting documents of recruits who decided not to partake in the research, while she assisted recruits who were uncertain of questions and allowed them to complete the questionnaire in their own time. Similar information and explanations were given to all four available companies in order to obtain objective and reliable information (*cf.* Polit and Beck 2008:429). Data collection took place over a period of three days and the collection pattern was maintained with each data collection event, as it occurred in the research plan.

Confidentiality of the completed questionnaires were maintained by limited access to the data, since they were locked away in a safe and secure steel cabinet before they were sent personally by the field worker to the researcher. The researcher completed the coding while the analysis was done by the Department of Biostatistics at the University of the Free State.

A data collection instrument is tested and the implementation is specified for the reason that it has to produce valid study results.

3.9 VALIDITY

Validity is established when confidence exists that intended measures in a study were indeed measured (Barker 2010:5). Validity is measured on a continuum to evaluate the use of an instrument for a specific purpose or group and not the instrument itself. The instrument may be valid for a specific situation, but not for another (Burns and Grove 2011:334; Bell 2010:120). The pilot study, adhering to the technical and content guidelines set out in Table 3.3, assisted the researcher in confirming the relevance of the questionnaire as research instrument. The quality of a research design is often reflected in how efficiently threats to validity were eliminated. All variables that the researcher aimed to measure were indeed measured, since the structure of the questionnaire ensured that all the study objectives were addressed, as is seen in Figure 3.3. Validity in a study therefore means to measure something and if measured in a different situation to still provide the same answers (Gomm 2009:376).

Validity could be maintained during data collection and had no impact on the interpretations of the findings. Participants furthermore had similar interests, experiences, environmental exposures, physical and psychological challenges to overcome and therefore minimized introduction of bias to the study. Controls were maintained by the implementation of a detailed plan such as obtaining informed consent and for the process of data collection that was found to be appropriate for the study. Aspects of validity considered in this study were face validity, content validity and criterion validity as described by Muijs (2004:64).

FACE VALIDITY

Face validity merely indicates that the instrument appears to measure what it is supposed to measure and is based on an expert's intuitive judgment. A warning is given not to use face validity as an alternative for other types of validity (Brink 2006:160). By just looking at an instrument, the investigator can draw conclusions about the validity of an instrument; it therefore is a subjective procedure and caution should be taken to ensure a more objective way of evaluation (Uys and Basson 2005:81).

The first method in establishing readability and clarity of content was to apply face validity to the data collection instrument, allowing constructive development of the questionnaire. The structure or the layout of the questionnaire was similar to that of other questionnaires and could therefore on face value be interpreted as a questionnaire.

The questionnaires were furthermore typed and instructions were found to be understandable after completion of the pilot study. Spacing between questions made it easier to analyse responses effectively. Response boxes were also typed towards the right hand side to make it easy for respondents to respond. The content of the questionnaire accurately measured the required concepts supposed to be measured by the questionnaire - this will be discussed under content validity.

CONTENT VALIDITY

Content validity refers to whether or not the content of the variables, in this case the questions on the questionnaire, accurately measured the required concepts that were supposed to be measured, along with whether the instrument dealt with all relevant aspects. The questionnaire did indeed address the aim and objectives formulated for this study. An extensive review of literature, as reflected in the chapter discussing the literature findings, also contributed to achieve content validity, as well as to obtain expert opinions through published data (Gomm 2009:7; Muijs 2004:64) (refer to content of Figure 3.3 reflecting how all questions addressing objectives of the study).

Several people from different departments were also asked to review the questionnaire content for correctness, validity and comprehensibility, as well as representivity and suitability. The above-mentioned measures strengthened content validity of questions (*cf.* Brink 2006:160). Content validity of the questionnaire was hence improved by the evaluation of experts in both Sport and Exercise Medicine and the Department of Biostatistics at the University of the Free State.

The researcher developed a questionnaire specifically for this study, on the basis of a literature review that already examined concepts associated with injuries sustained during BMT, as well as literature pertaining to professional athletes. Content validity was furthermore strengthened by attention given to sentence structuring for the reason that no leading questions were asked in the questionnaire, while participants could also give their own opinion or specify more relevant information under the option indicating “other”. Five recruits from the 2011 BMT group were recruited for testing the questionnaire during the pilot study.

Validity and reliability are closely linked and both need to be considered when selecting a research instrument, for the reason that there is no point in using a reliable instrument, which is not valid. Inversely so, there is no value in an instrument if it measures a phenomenon and does not have consistency in its utilization. Consequently, a good technique should meet the criteria of being both valid and reliable (Brink 2006:165). Reliability and validity therefore are assessment tools for correctness and consistency in order to obtain findings that is free from error (Barker 2010:70-71).

3.10 RELIABILITY

LoBiondo-Wood and Harber (2010:259) associate a reliable research instrument with trustworthy and reliable people who respond in a reliable and constant way. Likewise, reliability should yield the same results if repeated. Consistency, accuracy, precision, stability, equivalence and homogeneity are considered to be some of the key elements in reliability.

Reliability of a research instrument refers to the instrument reflecting similar results under constant conditions on all occasions (Bell 2010:119). It also signifies consistency with which the instrument measures quality, in other words, the fewer the discrepancies, the higher the reliability. Another way to describe reliability is accuracy, because an instrument is only reliable if the measurement is accurate (Polit and Beck 2006:324; Brink 2006:163).

The purpose of reliability is to contribute to the quality of a study instrument in achieving consistency, and therefore contributes to sound research findings (Polit and Beck 2006:324; Muijs 2004:72). The research design, methodology and measurement tools should be evaluated in order to determine the accuracy and similarity of findings, if repeated (Barker 2010:75). The clear description of data collection and the subsequent data analysis assisted in obtaining reliability in this study. The research design, methodology and measurement tools should be evaluated in order to determine the accuracy and similarity of findings, if repeated. Aspects to be considered in reliability, described by Polit and Beck (2006:324-327), are internal consistency and equivalence.

An ability to generalize relates to the expectation that instrument reliability and validity are of such a nature that it could be used in another study, and would still be applicable (Brink 2006:165-166). Injuries during BMT will always occur due to physical demands made on recruits during the training. Since BMT in the SANDF is standardized, this questionnaire could also be used at other BMT sites, therefore findings from the study could be generalized and applied to other BMT programmes in the SANDF.

Adherence to ethical issues in research is a fundamental practice of research.

3.11 ETHICAL ISSUES

The word ethical relates to issues that are morally right and wrong (Cambridge 2008:478). Ethics relates to the application of moral principles to prevent harm or wrong doing while it furthermore promotes good, respectful and fair behaviour towards research subjects. All researchers need to be concerned with ethics and ethical considerations have to be applied throughout the research process. Burton *et al.* (2008:51) pointed out that ethics has always been acknowledged as a central element in medical and scientific research and that the practice of obtaining ethical approval prior to commencing with investigations is essential to comply with prescribed research procedures. Research ethics, as explained by Blaxter *et al*. (2006:158-159) comprise matters such as the nature of agreements or contracts

made with the research subjects and obtaining informed consent for research questionnaires. In addition, it involves obtaining agreements for the use of data, data analysis, writing of reports and dissemination thereof. It finally entails keeping to agreements that have been reached with the participant.

Various methods, such as ethical guidelines and research contracts, have been used for many years in order to protect participants from harm. The Nuremberg Code and the Declaration of Helsinki provide the foundation of ethical guidelines that protect human rights (Bell 2010:45; Burton *et al.* 2008:51). In South Africa, the South African Medical Research Council developed ethical guidelines, known as *Ethical Considerations in Medical Research* for this purpose. The Human Sciences Research Council developed a Research Code for research in Human Sciences, and the South African Nursing Association published *Ethical Standards for Nursing Research* to ensure honesty and integrity in conducting research. Efforts from organizations and professional bodies, as mentioned before, have shown the way forward to formalized procedures, guidelines, contracts, code of practice and protocols for research. Contributions include subject matter such as ethical guidelines, the purpose of research, privacy, confidentiality and safety (Bell 2010:45; Burton *et al.* 2008:51).

Opie (2004:24) states that research involving people has the potential to cause damage, usually unintentionally. Ethical committees play an important part in ensuring that no harmful research is allowed. These codes of ethical research were developed to guide responsibilities of the researcher in sharing information truthfully and to balance the risk and benefit ratio with adequate protection from risk or harm for the subjects (Brink 2006:30-31). Participants in the population of a research study can be vulnerable and open to exploitation, consequently embarking on their right to self-determination. Distinction between moral, legal and ethical approaches is a challenge, because individuals have to be protected physically, emotionally and psychologically. In addition, ethical research demands that groups be given the same opportunities and enjoy the same potential benefits in order to be fair and ethical (Burton *et al.* 2008:51-52). The following helpful guidelines are to be considered prior to commencing with a study:

- All participants must be informed about the research purpose and activities;
- participation must be voluntary;
- incentives to partake should be within reasonable limits;
- information divulged by participants must be stored securely;
- anonymity and confidentiality of information must be assured;
- adherence to participants' right to withdraw at any stage, without negative consequences or loss of services;
- participant must give informed consent ;
- intrusion of privacy should be avoided; and
- additional stress should be minimized (Burton *et al.* 2008:51-52).

Botma *et al.* (2010:3,17) provide information about the United States of America's National Commission for the Protection of Human Subject of Biomedical and Behavioral Research that was established in 1978. This Commission compiled the Belmont Report in which the three fundamental ethical principles based on human rights are described as (1) respect for persons, (2) beneficence and (3) justice.

3.11.1 PRINCIPLE OF RESPECT FOR PERSONS

The principle of respect for persons is the first ethical principle described in the Belmont Report and includes a participant's right to self-determination. Individuals should have the right to decide whether or not to participate without possible risk of prejudicial treatment and may furthermore withdraw from the study at any time, or refuse to give information. In addition, no coercion may be used to influence participants to take part in a study. People in a subservient position may feel obligated to participate in research due to a researcher's position and may be fearful of penalties (Botma *et al*. 2010:6, 8; Polit and Beck 2008:171; Brink 2006:32). The research population of this study consisted of recruits doing BMT that were in fact subservient in principle, due to the military structure, however, the researcher was not part of the command structure of the BMT programme and therefore was unable to influence or penalize recruits.

A civilian RPN was recruited and trained as a field worker to manage the administration of the information leaflet, consent form and the questionnaire (see Addendums E, F, G) as part of data collection. The consent form clearly stated that that the recruits would not be harmed if they chose not to participate, therefore 18% of recruits did not complete the questionnaire and none of the participants withdrew while completing the questionnaires. This was important, since participants were protected from any negative consequences if they opted not to partake, especially since in a military milieu recruits do not get the option to "opting out" of activities. Equal opportunity to partake or to withdraw from the study was extended to recruits when privacy and informed consent were discussed - in this manner the principle of respect was upheld.

The field worker was friendly and courteous towards recruits and they were given an opportunity to clarify uncertainties, in order to benefit not only the recruit, but also the study.

3.11.2 PRINCIPLE OF BENEFICENCE

The second fundamental ethical principle based on human rights as described in the Belmont Report, is beneficence and is explained by Polit and Beck (2008:170) as one of the most fundamental ethical principles in research, as well as that the researcher has the responsibility to minimize harm and maximize benefit to participants. The researcher must ensure the well-being and the protection of participants from discomfort and harm of any kind, be it physical, emotional, spiritual, economic, social or legal. Good manners and clinical judgment should also be practised to avoid harming participants during research (Botma *et al.* 2010:20-24; Brink 2006:32). The risk/benefit ratio ought to be considered as a central part of beneficence. Benefits should actually be referred to as the hoped-for benefits to the society, as well as the participant. Potential benefit should outweigh the risks for research to be justifiable (Botma *et al.* 2010:20-24). During completion of the questionnaire no participant reported any discomfort and the field worker did not observe any participant suffering from any type of discomfort. The content of the

questionnaire did therefore not expose participants to experiences that could cause emotional trauma.

3.11.3 PRINCIPLE OF JUSTICE

Justice, the third fundamental ethical principle portrayed in the Belmont Report, indicates fair treatment and adherence to information shared. Researchers are therefore not allowed to collect data without the knowledge of participants (Botma *et al*. 2010:13, 19-20). The principle of justice relates to the rights of the participant concerning fair selection and treatment; in other words, selection of a population ought to be done for the right reason and not because of the fact that the population could be manipulated or that they would be easily obtainable. People should be given an opportunity to participate in research because of the fact that their contribution relates to the research, and not just because they are easily accessible. No exploitation of participants should be tolerated on bases of sexual orientation, class, age, gender, race and religion. Subjects must also be treated fairly and the rights of the participant should be honoured at all times (Botma *et al*. 2010:13; Moule and Goodman 2009:57). In this study it was necessary to ask recruits undergoing BMT to participate in the research in order to address the aim and objectives set by the study. The researcher was sensitive not to exploit the military milieu in order to persuade recruits to participate in the study. The contribution of the recruits as research participants was essential to the outcome of the study. Privacy and informed consent are henceforth discussed as part of the principle of justice.

PRIVACY

The right to privacy is crucial in research and the researcher should therefore refrain from collecting data not relevant to a specific study that intrude on the privacy of the participants. Participants also have the right to expect that information will remain private and anonymous (Brink 2006:33-34). The questionnaire was evaluated by military and medical experts in order to protect the privacy of participants and to assist in the formulation of questions relevant to the study objectives and yet not to be sensitive in nature (see Addendum G).

INFORMED CONSENT

Informed consent relates to concepts such as voluntary participation and protecting participants from harm. The researcher should address elements such as addressing the type of information required for the study; ensuring that the participant understands what information is essential to the study; as well as to focus on the understanding of the participant regarding giving consent and the choice to withdraw (Brink 2006:35). Therefore participants must be fully informed about their rights and the purpose of the study. The researcher should, as a result, compile an information leaflet to inform participants about the study while using a clear layout, large enough reading font, as well as using appropriate language (Burns and Grove 2011:22-123; Burton *et al.* 2008:57; Brink 2006:37). The researcher compiled an information leaflet and informed consent form that do meet the abovementioned criteria, in order to adhere to the prescribed element of informed consent.

The leaflet compiled by the researcher was written in English, the official language of the military, containing details regarding the research, and extended an invitation to recruits to participate. Also included in the leaflet was a detailed statement regarding the research purpose as well as study objectives. Participants were informed about the selection criteria and the data collection procedures. Furthermore, a description of risks and discomforts together with benefits gained through the study was also discussed. The researcher gave assurance of confidentiality, voluntary participation and that they could withdraw without any consequences. Participants were also informed that their questions would be answered by the field worker and of honouring agreements pertaining to time and venue. After having discussed and reading the information leaflet, participant had the opportunity to participate or to withdraw. The consent form also mirrored the content of the information leaflet in order to rule out possible misunderstanding (see Addendum E, F). The researcher also confirmed with the field worker that participation was done by choice and not by any form of coercion.

3.12 DATA ANALYSIS

Hofstee (2006:148) points out that data without analysis are without meaning and only when analysed and used to substantiate a point, will it be considered as evidence. Statistical analysis are used to examine numerical data (Burns and Grove 2011:372).

Data collection was done at the end of the BMT phase, prior to the field phase; however, at the time of data collection; the Foxtrot company (n=104) was already preparing for the field phase and therefore was not available to complete the questionnaire. The entire available participant population thus consisted of 378 (82%) participants, of which 85 (22.49%) recruits completed the section of the questionnaire that reflected that they indeed had sustained an injury. The researcher coded all (n=378) questionnaires and the data were consequently analysed by the Department of Biostatistics at the University of the Free State. Descriptive statistics, namely frequencies and percentages for categorical data and means with standard deviations or medians for continuous data, were calculated. Relevant groups were compared by means of chi-square tests for categorical data or t-tests for continuous data.

DESCRIPTIVE STATISTICS:

Descriptive statistics are normally used to summarize and describe data and thus convert and condense a collection of data in an organized picture, in order to add meaning to the research (Barker 2010:72; Brink 2006:71).

- Mean: The average sum of a set of values, used to determine, for example, the mean age of many people.
- Frequency distribution: Arrange data in ascending order, in other words, from the lowest to highest value.
- Standard deviation: Calculate the average deviation of the values from the mean.
- Range: The distance between the highest and lowest value that gives a picture of the distribution of data.

- Percentages, percentiles and quartiles: The frequency at which something occurs, such as 60%. Percentiles indicate the point below which a percentage of values lies (Barker 2010:73).

INFERENTIAL STATISTICS

Inferential statistics use sample data to make an inference about the population of the study (Barker 2010:72; Brink 2006:171). A t-test is used to examine the difference between means of two sets of values.

Analysis of variance (ANOVA) examines the difference between several means:

- Correlation: identifies an association between variables in the case where a variation in one is related to a variation in another;
- crohnbach's alpha is a reliability index and is used to measure the internal consistency of a multi-itemed measurement tool, for example, as an anxiety scale or an assessment tool; however was not used in this study; and
- a chi-square test compares collected data in the form of frequencies or percentages (Barker 2010:73).

The researcher should be fully aware of and maintain privacy with respect to electronic processing and dissemination of data during data analysis. Lastly a post-hoc analysis is conducted and these stages contribute to insights into analysed data (Burns and Grove 2011:372). Appointments were made with the Department of Biostatistics in order to obtain a better understanding of the analysed data, as well as to verify technical aspects regarding the analysis. In addition, the interpreted analysis was again submitted to the Department of Biostatistics for further evaluation of accuracy.

3.13 CONCLUSION

Key aspects regarding the context of the research methodology were discussed. The reader was guided through this chapter by considering the most appropriate paradigm and design. Aspects regarding quantitative, non-experimental and descriptive research were discussed as well as the strengths and limitations of a

quantitative research design. Consequently, selecting the correct research technique, of which details on the questionnaire was given, with furthermore focusing on the strengths and limitations of a questionnaire. Information was also provided on the implementation of a questionnaire, selecting an appropriate population, sampling and performing a pilot study that would lead to reliable results. The aim of the study was to describe the exercise-related injury profile amongst recruits during BMT at 3 SAI Bn at Kimberley in order to consider potential nursing care and recommendations to be provided. The identified objectives for the study were to describe the demographic, socio-economic and medical history as well as the type and mechanism of exercise-related injuries at 3 SAI Bn. Through the data collected it was possible to achieve the objectives, therefore it may be stated that the choice of methodology was correct and that the aim and objectives of the study will be attained. The next chapter will give more details on data already analysed.

CHAPTER 4: DATA ANALYSIS

4.1 INTRODUCTION

The intention of this chapter is to describe findings of analysed data as obtained from the self-reported questionnaires. Findings will be discussed and integrated throughout the three sections of the questionnaire involving *intrinsic and extrinsic risk factors* as well as the *training programme,* in order to outline the injury profile of recruits during BMT. Data will furthermore be presented by means of visual descriptive statistics, thereby serving as evidence for nursing practice on exercise related injuries. Figure 4.1 indicates that the research process at this stage is currently in phase three, depicted as the interpretive phase.

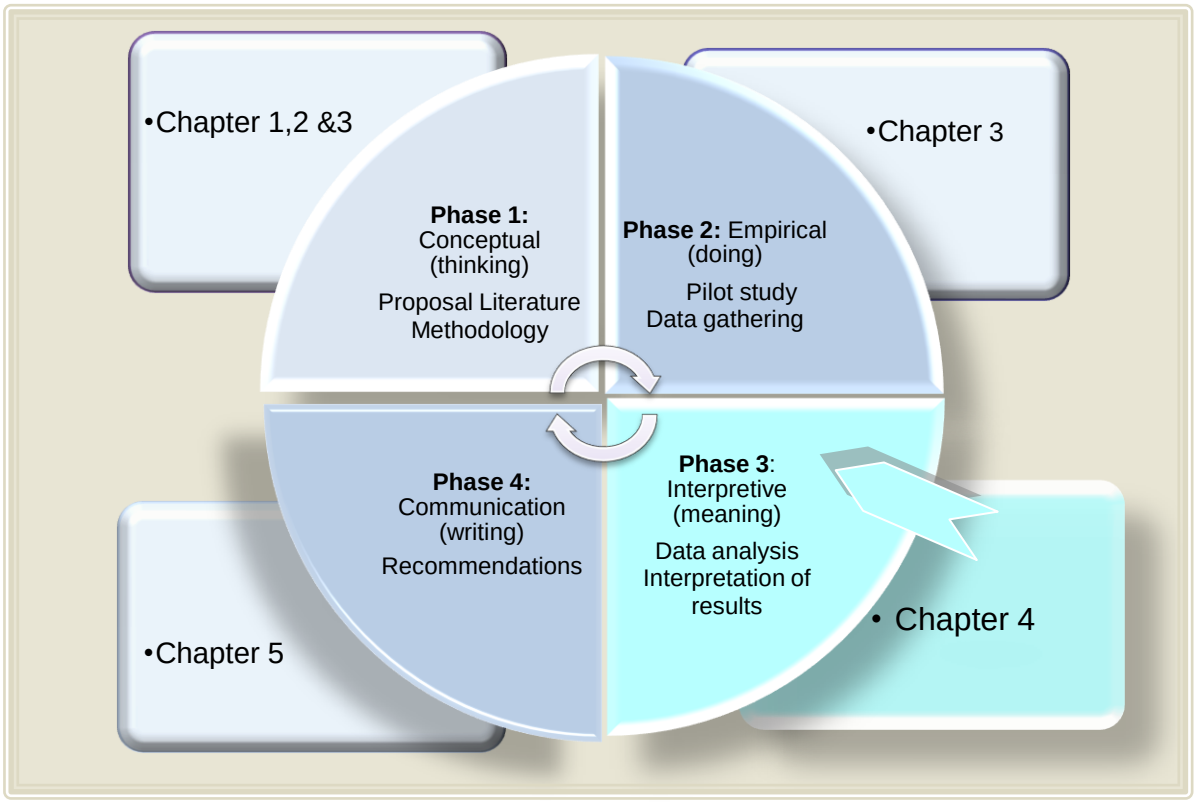


Figure 4.1: The research process in the interpretive phase.

4.2 BACKGROUND

The objectives of the study guided the researcher in discussing the findings that emanated from the analysis of the data gathered by means of the questionnaire. The entire purposive sample will be included when describing findings from Question 1-24, while only results from injured participants will be incorporated in Question 25-64. The questionnaire consisted of:

- Section A, intrinsic risk factors, questions 1-17;
- Section B, extrinsic risk factors questions 18-45, and
- Section C involving the BMT programme, questions 46-64.

Figure 4.2 outlines the content of the questionnaire, linked with the objectives formulated for the study.

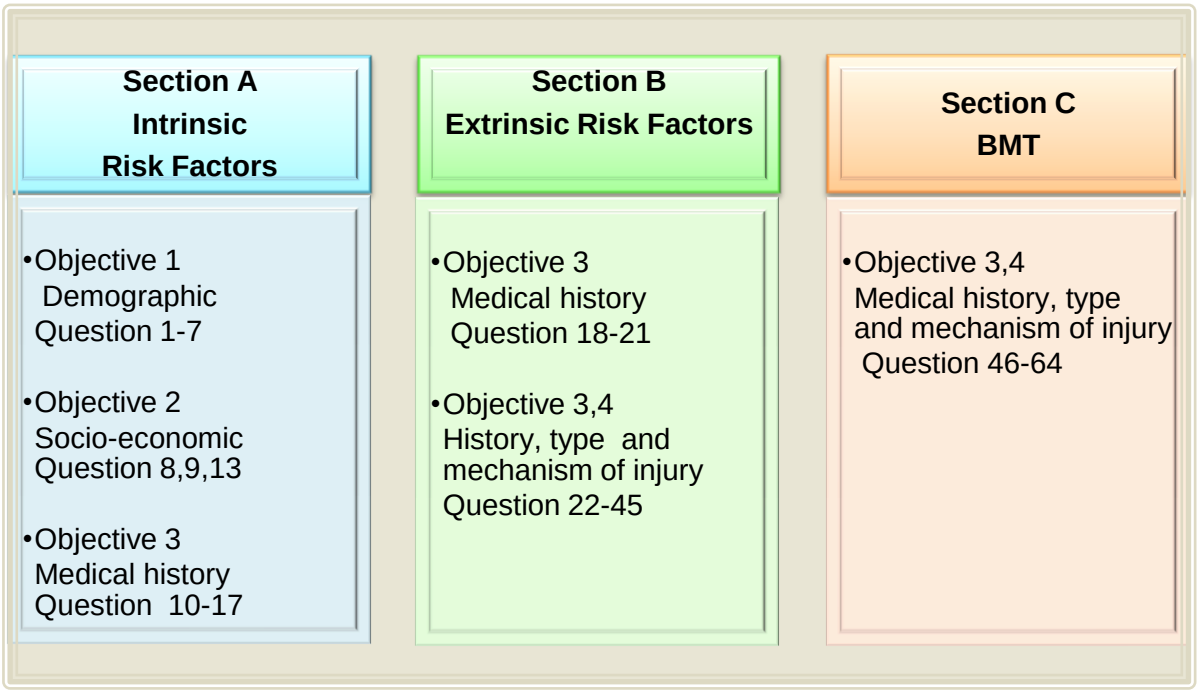


Figure 4.2: Link between questions in the questionnaire and study objectives

It is important for the reader to consider the following aspects when interpreting the values presented as totals and percentages in the various tables and figures in this chapter.

- All participants did not need to complete all 64 questions since questions 25-64 were only completed by participants who reported on injuries:
- For unknown reasons, a number of participants did not answer all the questions;
- A number of questions only necessitated a response if a positive response was given to the previous question;
- Only significant data differences or similarities between male and female will be highlighted to provide an overview of gender differences;
- The entire recruit population will be indicated as (N), whereas the cumulative frequency of participants will be specified as (n); and
- A total (P) value lower than 0.05 will also be considered as statistically significant.

4.3. INTRINSIC RISK FACTORS

Intrinsic risk factors refer to factors directly related to aspects unique to an individual's body (Ghani Zadeh Hesar *et al*. 2009:1057). The researcher will thus describe the intrinsic factors pertaining to *demographics, socio-economic* background along with the *medical history* of participants.

4.3.1 DEMOGRAPHIC ASPECTS

Demographics refer to the quantity and characteristics of a population (Cambridge 2008:372). Demographic aspects (questions 1-7) will be discussed as *ethnic distribution, gender, language, body mass index, age and qualification.* The South African population of nearly 52 million people is characterized by a diversity in *ethnic distribution* with Blacks being the majority by almost 80%, Coloureds and Whites each accounting for almost 9%, while Indians are in the minority at 2.5% (SouthAfrica.info n.d:online). The overall ethnic distribution of BMT participants was calculated at 83.29% (n=314) Black, Coloured 12.73% (n=48), White 2.65% (n=10) and Indian 1.33% (n=5), as is portrayed in Figure 4.3. The BMT participant group is thus not fully representative of the South African ethnic population, with Black and Coloured insignificantly over-represented as opposed to White and Indian slightly

under-represented. However, the SANDF aims to incorporate policies on political, organizational, cultural, and demographical transformation in order to obtain transformational outcomes (Department of Defence 2008:2).

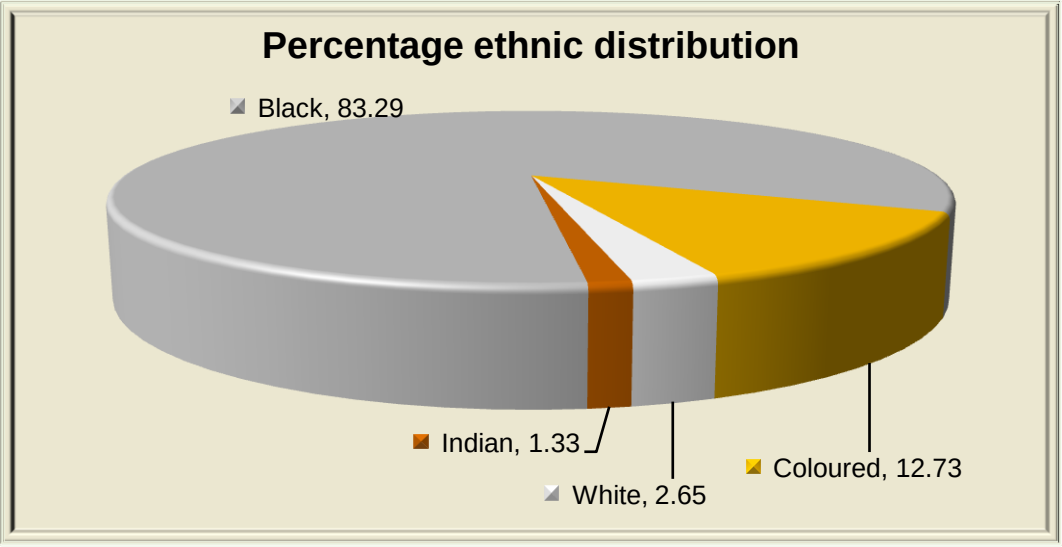


Figure 4.3: Percentages of ethnic distribution of participants

Gender distribution in South Africa, published in 2012 (South Africa.info n.d:online), reflects females (51.3%) to exceed the male population (48.7%) by almost 2%. The BMT programme of the SANDF is gender integrated; however, female participants (46.88%, n=173) were almost 6% less represented compared to males (53.12%, n=196). Although indicated data may not be a true reflection of the entire BMT group, it however provides an indication of how well gender integration has taken place in a previously male-dominated organization. Gender was also found to be a statistically significant risk factor for injuries in this study (P=2.351E-10) as 19% (n=64) of females were injured while only 6% (n=20) of males sustained injuries.

In addition, South Africa recognizes eleven official *languages.* The most spoken language in the media, politics and business is English; however, it is only the fifth most spoken home language (9.6%) in the country. Furthermore, the nine provinces each also has a unique language distribution; however, 22.7% of South Africans speak isiZulu, 16% isiXhosa and 14.29% speak Afrikaans (South Africa info n.d:online). Study participants were from all over South Africa and had a different language distribution with Setswana in the highest category at 30.42% and English

at the lowest with 9.52%. The participant language distribution in percentage is portrayed in Table 4.1.

Table 4.1: Participant language distribution in percentage

LANGUAGE	FREQUENCY	%
Setswana	115	30.42
Sesotho	62	16.40
isiXhosa	61	16.14
isiZulu	60	15.87
Afrikaans	54	14.29
English	36	9.52
Other 7 languages	1	0.26
TOTAL	398	102.9

Adult *height* between males and females, as well as ethnic groups, often differs significantly. South African males have an average height of 1.69 m and females 1.59 m (Disabled World 2008:online). The mean height (1.57 m) of female participants was almost similar to the above-mentioned data; however, males reported to be 4 cm taller (1.73 m) than the average South African male population. *Body mass index* acceptable for recruitment ranges from 18 to 30 (Department of Defence 2009:A3). It was therefore expected to report a median body mass index of 24.34 for this participant group because it was evaluated prior to BMT. Body mass index was not found to be a statistically significant contributing risk factor in this study (P=0.4292**).** For additional comparisons of demographical differences between male and female see Figure 4.4. The percentage in this table does not calculate to a hundred percent because some participants spoke more than one language.

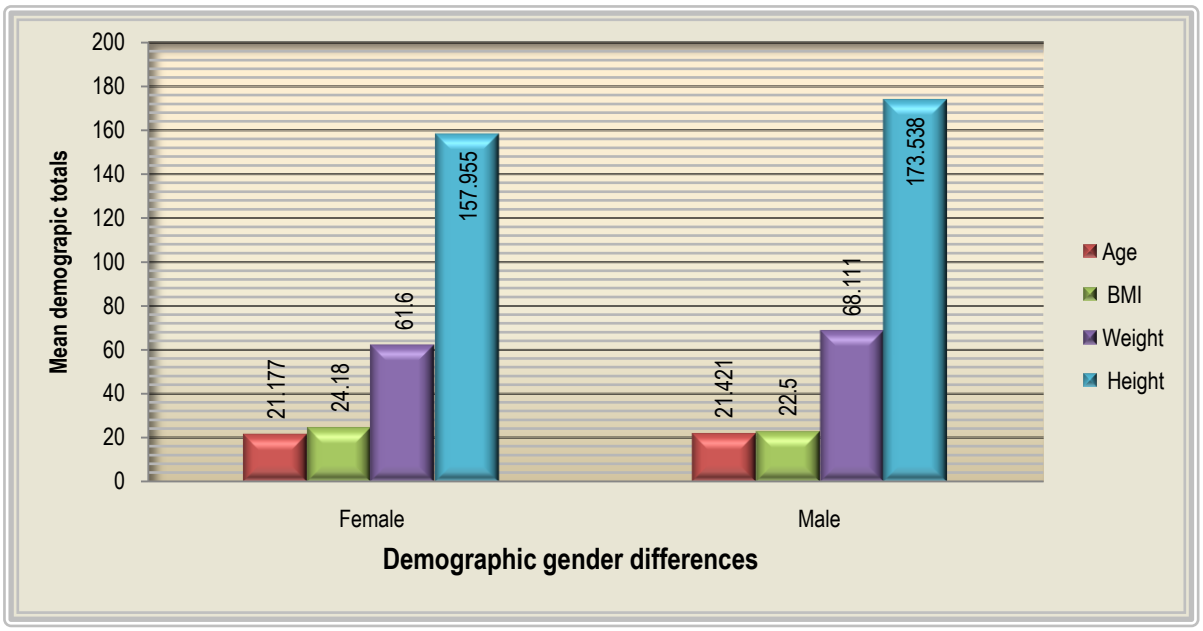


Figure 4.4: Demographic gender differences

Noteworthy was the mean *age of* 21.53 years (n=361) of participants. This is higher than the expected entry-level age of 18-22 years, could possibly have contributed to almost a third of participants (31.48%) already having obtained a tertiary qualification prior to the BMT.

Education is an important indicator for personal well-being and development of a country and furthermore has a positive impact towards development of living standards. In South Africa in 2011, only 3.5% of Blacks aged 18-29 were studying, 3.8% Coloured, 14.9% Indian, in contrast to 20% of the White population. However, tertiary qualifications in South Africa increased during the period 2002-2011 from 9.2% to 11.5% (Statistics South Africa 2012:2). The education level of participants was significantly higher than that of the average South African population, since participants were required to be in possession of a grade 12 certificate for selection purposes. Furthermore, a significant percentage of the participants had additional qualifications such as certificates (18.73, n=69) and diplomas (8.73, n=33), while 4.5% (n=17) had managed to obtain a degree. Figure 4.5 demonstrates the distribution of additional qualifications amongst participants.

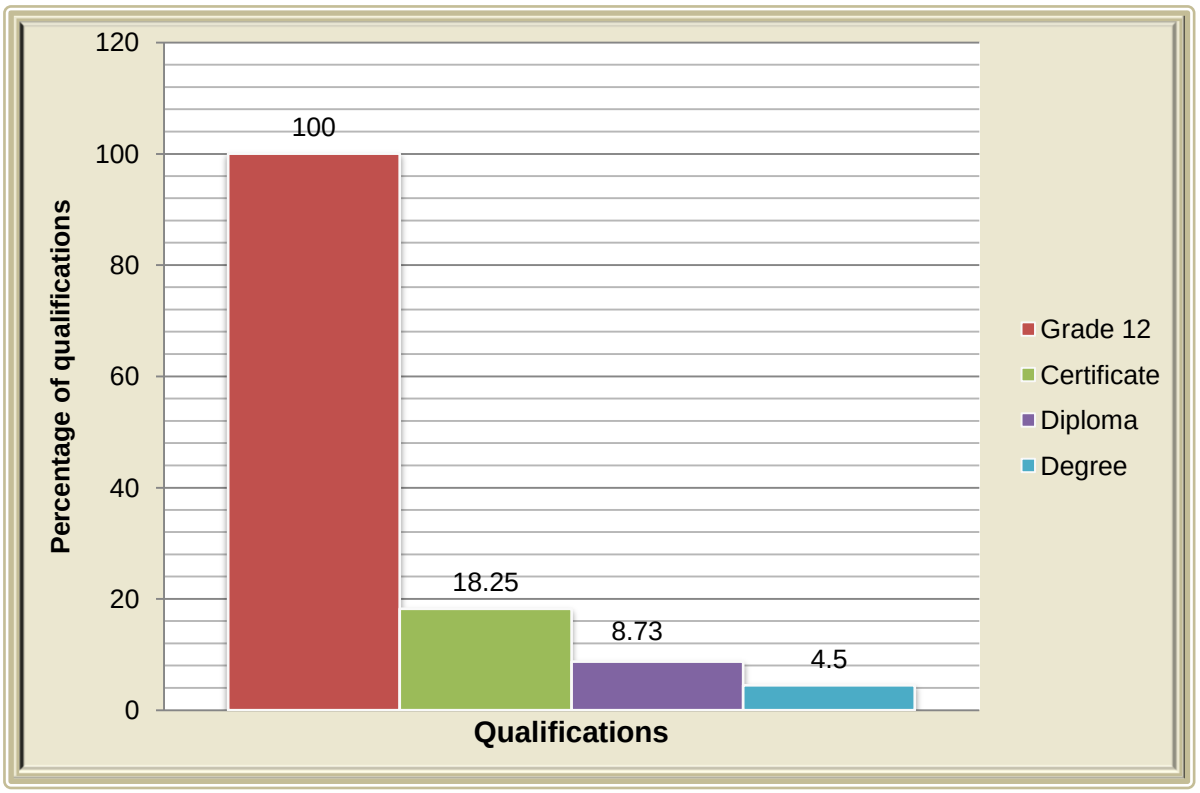


Figure 4.5: Percentage distributions of qualifications amongst participants

The percentage of qualifications obtained by ethnic distribution indicated that 4.85% (n=15) of Black participants obtained degrees and 20%, (n=2) of the White participant population. See Table 4.2 for more detail on qualifications obtained by different ethnic groupings.

Table 4.2: Qualifications of different ethnic groupings

ETHNICITY	QUALIFICATIONS				
	Grade 12	Certificate	Diploma	Degree	Total
Black (n=)	198	66	30	15	309
%	64.08	21.36	9.71	4.85	
Indian (n=)	5	0	0	0	5
%	100.00	0.00	0.00	0.00	
Coloured (n=)	42	3	3	0	48
%	87.50	6.25	6.25	0.00	
White (n=)	8	0	0	2	10
%	80.00	0.00	0.00	20.00	
Total	253	69	33	17	372

4.3.2. SOCIO-ECONOMIC DATA

Changes to the environment and socio-economic status determine how healthy or unhealthy people will be and furthermore provide an indication of future expectations on health issues (Question 8, 9, 13). Therefore, in order to improve the health and well-being of people requires an analysis of the environment and socio-economic status of such a population (Ataguba *et al.* 2012:189).

According to Statistics South Africa (2012:22), White (85%) and Indian (71%) people were much more likely to stay in a dwelling with six or more rooms in contrast to the Coloured (42%) and Black (31%) population who had an average of 5.3 rooms per dwelling. However, participants in this study had a mean of six *rooms per dwelling* sharing it with six (6.2) people. Seen in the light that the majority of the population was Black (83.29%) and Coloured (12.73%), these results correspond with the more privileged White and Indian population groups reported by Statistics South Africa. However, considerable better living standards were in fact found to have played a statistical significant role in actually contributing to injuries sustained by recruits (P=0.0121).

Statistics South Africa (2012:40) furthermore determined that households experiencing inadequate or severely inadequate access to food were calculated at 19.4% of the total South African population. Data obtained on how many *meals* participants had per day, indicated significantly improved access to food amongst participants than is the case in the rest of the South African population. One per cent (1.08%, n=4) of the participants had less than one meal per day, while three per cent (3.52%, n=13) had one meal per day; 19.24% (n=71) had access to two meals, and more than half (51.49%, n=190) reported to have had three meals per day. This indicates that almost a quarter of the participants (24.66%, n=91) had adequate meals. This confirms findings of Statistics South Africa (2012:22) that improved education may be identified as an indicating factor of improved living standards and access to food of a population (Statistics South Africa 2012:22). Limited access to food prior to BMT by injured participants was not statistically significant (P=0.6460).

4.3.3. MEDICAL HISTORY

The medical history (Questions 10-17, excluding question 13) comprised details regarding *smoking habits, hand dominance* and the use of *chronic medication* as well as episodes of *cramps*. Females were also requested to report on *contraception* use, *menstrual periods as well as possible abortions or miscarriages,* six months prior to BMT.

The percentage of *smoking* South Africans aged >15 years, are considered as 22%, (Pfizer 2012:online). Studies showed that habits such as cigarette smoking were found to have affected injury prevalence (Finch *et al*. 2011:70; Havenetidis and Paxinos 2011:1111). In the case of the participants in this study, most did not smoke during the period prior to the BMT, while 48 females and 19 males, as well as two participants not indicating their gender (n=69) acknowledged their smoking habit. They *reportedly* smoked 1.127 cigarettes per day, for the duration of 8.5 months prior to BMT. Thirty-two per cent (31.91%, n=15) of smoking participants sustained injuries, therefore, participants who smoked indeed sustained more

injuries than those who did not smoke; however calculations were not statistically significant (P=0.6687). Table 4.3 depicts an indication of the percentage of injured smokers.

Table 4.3: Injured smokers

SMOKER	INJURED		
	YES	NO	TOTAL
Yes (n=) %	15 31.91	32 68.09	47
No (n=) %	70 23.97	222 76.03	292
Total injured participants	85	254	339

Informal observation by the Occupational Nursing team based at Tempe Military Base, Bloemfontein, determined that most stress fractures amongst recruit were located on the left side the body. The researcher then aimed to determine *hand dominance* amongst recruits doing BMT. Results confirmed that 90.76% (n=324) of participants were right-handed and 9.24% (n=33) were left-handed. Findings were not statistically significant as 72 of 85 injuries were on the right side.

On the question of treatment with chronic medication, only 2% (n=7) of participants indicated that they used *chronic medication* such as anti-histamines and one participant received a prescription for haematinics during BMT. In addition, anti-depressants and bronchodilators were also used; this contradicts recruitment regulations and could possibly be attributed to non-disclosure at the time of medical assessment (Department of Defence 2009:A5). Another female participant from Alpha Company indicated that she had been diagnosed with tuberculosis of unknown origin.

Furthermore, vigorous activity and/or exercise, or on the other hand, long periods spent sitting may lead to muscle fatigue and *cramps*. Therefore, hyper-excitability of nerves, stimulates muscle to limit movement, in order to stabilize the injured area.

More than a third (32.1%, n=113) of participants confirmed to have had cramps in lower legs, whereas 67.9% (n=239) did not report cramps; therefore, cramping was determined to be a significant contributing risk factor for injuries (P=9.914E-05).

4.3.4 FEMALE MEDICAL HISTORY

Amenorrheic or oligomenorrheic athletes have lower bone mass mineral density than regularly menstruating athletes. Bone mass mineral density continues to decline in amenorrheic athletes raising concerns of irreversible bone loss. Therefore, women who have had no menses during the previous year, require extra observation during BMT in order to prevent stress fractures (Nichols *et al*. 2007:1007; Schaffer *et al.* 2006:8).

In this study 43.29% (n=71) female participants reported to never have used *contraception,* while more than half of females (51.22%, n=84) used injectable contraception and only 4.88% (n=8) used oral contraception. History of female *menstrual periods* indicated that more than half of participants (65.48%, n=110) reported regular *menstrual periods* while 20.83% (n=35) had irregular periods and 13.69% (n=23) had amenorrhea. Reported data on miscarriage or abortion revealed that more than 5% (5.36%, n= 9) of female participants either had a baby or a miscarriage six months prior to BMT. In this study the use of contraception (P=0.2282), amenorrhea (P=0.7208) and smoking (P=0.354), as well as miscarriages (P=0.7182) was not identified as significant contributing risk factor for injuries. Figure 4.6 gives an outline of contraception use and menstrual periods of female participants.

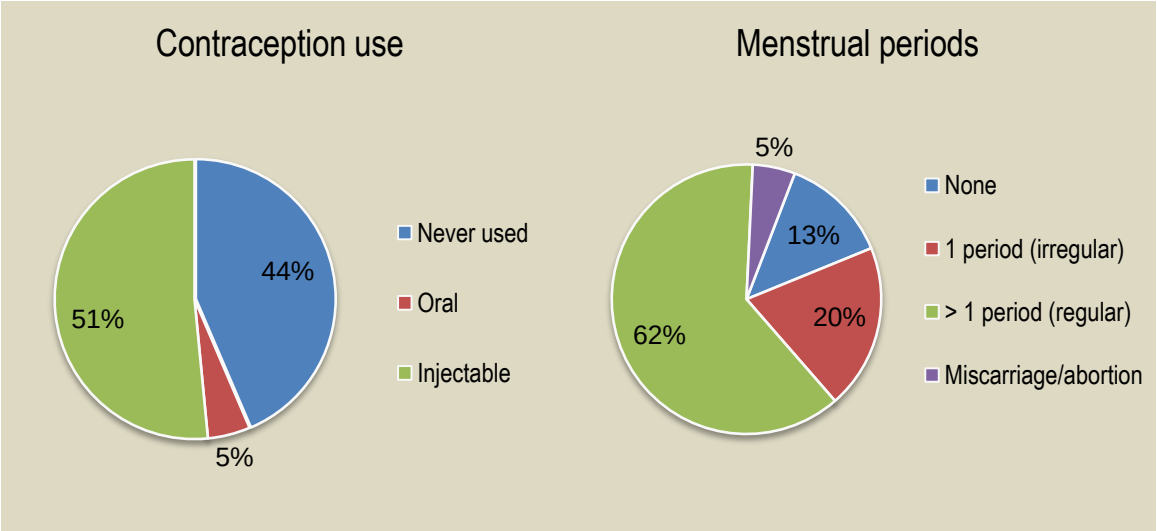


Figure 4.6: Percentage of contraception use and menstrual periods amongst female participants

4.4 EXTRINSIC RISK FACTORS

Extrinsic risk factors contributing to injuries relate to insufficient variation of exercises, duration, or frequency of activities (Brunkner and Khan 2012:25). A semi-sedentary lifestyle has also been proven to be a risk factor for injuries (Galit *et al*. 2008:181). Therefore, regular exercise is valuable to all ages for the long-term health benefits as well as for the augmentation of well-being and injury prevention (Joy *et al*. 2009:489). The researcher therefore had to obtain information regarding *fitness, sport participation* and whether they indeed had sustained injuries and the medication subsequently prescribed (Questions 18-24).

4.4.1 SPORT AND FITNESS HISTORY

Participants were asked how they rated their *fitness* level prior to commencing with BMT for the reason that an individual's physical activity, the level of fitness and skill level were found to have an impact on injury prevalence (Finch *et al.* 2011:70; Havenetidis and Paxinos 2011:1111).

The self-reported *fitness level* of participants prior to BMT was considered by 37.3% (n=137) of participants as fair, almost 40% (39.73% n=147) as good, while the remaining 20% were divided into excellent (10.54% n=39) and poor (12.7%, n=47) categories. However, when evaluating the injury rates, it was evident that only a quarter (25%, n=16) of females who reported their fitness to have been good, were injured, while almost three quarters (71.87, n=46) who indicated their fitness as poor and fair, also had sustained injuries. Therefore, fitness (P=0.0091) was found to be a contributing risk factor for injuries.

The reported fitness levels almost contradicts reported exercise participation, reflecting one third (36.64%, n=133) indicating not to have exercised at all, with nearly two thirds (63.36%, n=230) claiming to have exercised. Sports participation (P=0.0296) significantly reduced injury prevalence. The mean hours determined for *sport participation* were 5.53 hours per week (n=324).

Weight-bearing physical activity such as gymnastics, volleyball or rugby has a better osteogenic effect, while playing soccer involving the lower limb is also associated with higher bone mineral density. However, sports without impact loading such as swimming, rowing, and cycling do not have the same effect on bone (Nichols *et al*. 2007:1001). Types of sport participation three months prior to BMT is depicted in Figure 4.7 and was mostly weight bearing in nature (73%, n=223), with soccer being the most popular sport (32.8%, n=124), followed by running (15.08%, n=57). Injury rates were significantly reduced by participation in weight-bearing sports (P=0.0023).

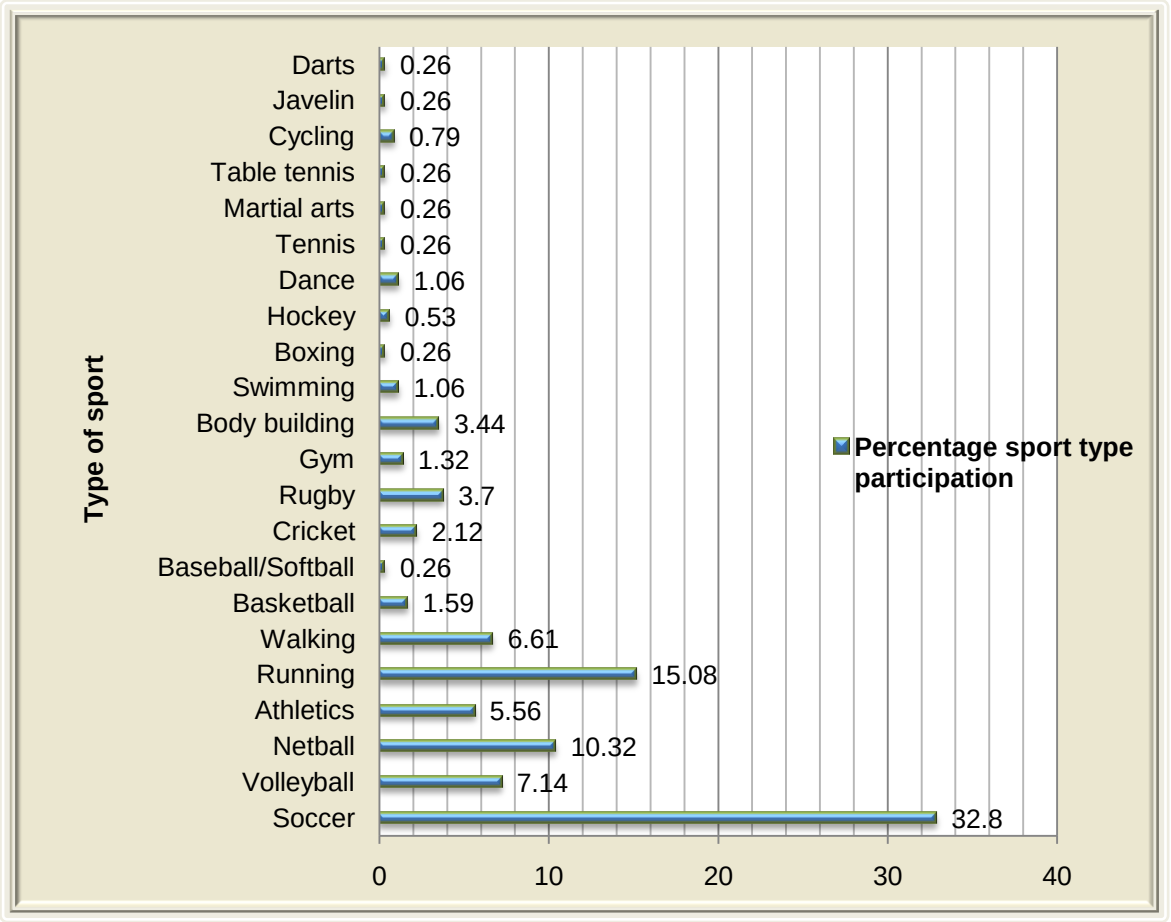


Figure 4.7: Type of sports participation prior to BMT

4.4.2 INJURY HISTORY

A previous study on overuse injuries conducted in South Africa during BMT determined an overall 31.9% injury incidence amongst recruits (Jordaan and Schwellnus 1994:241). The injury rate in the current study was slightly lower with 25.07% (n=85) injured, of which 41.6% (n=64) of females and 11.3% (n=20) males were injured, with one participant not indicating the gender. In this study, gender played a statistically significant role with the allocation of restricted duties (P=0.0063) and light duties (P=0.0015), as females were more injured than males and required additional restrictions. Figure 4.8 depicts the percentages of injured participants.

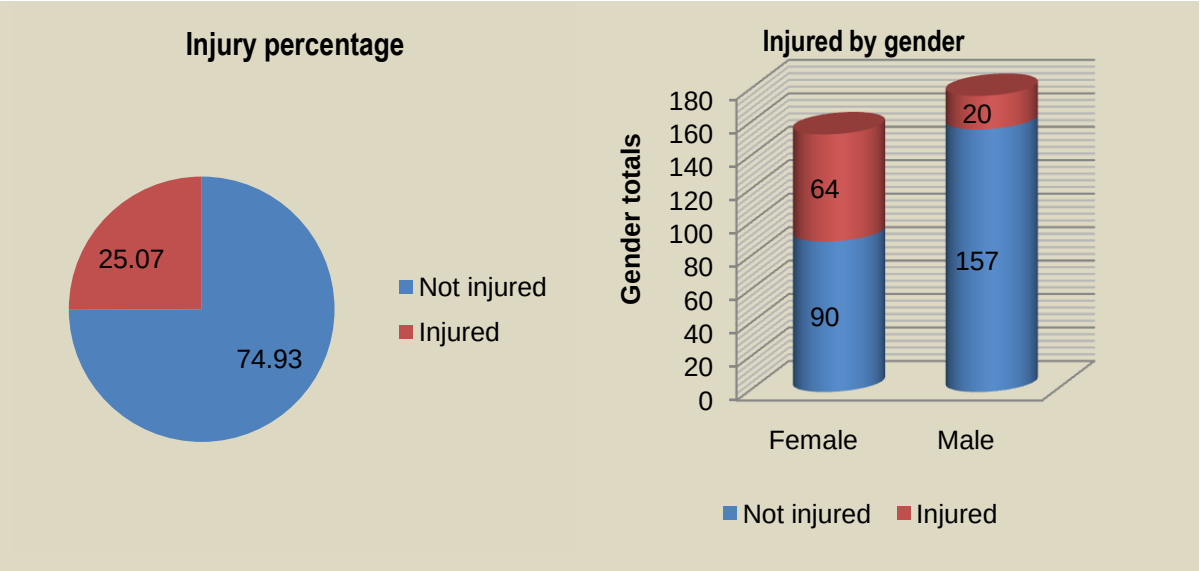


Figure 4.8: Percentages and totals of injured participants

Injuries among ethnic groupings differed significantly, since no injuries were reported by Indian participants (n=4) while only 22% (n=62) of the Black participants were injured. Table 4.4 outlines injuries according to ethnic groupings.

Table 4.4: Injuries according to ethnic groupings

ETHNICITY	INJURED		
	Yes	No	Total
Black %	62 22.14	218 77.86	280
Indian %	0 0.00	4 100.00	4
Coloured %	19 42.22	26 57.78	45
White %	4 40.00	6 60.00	10
Total	85	254	339

Treatment prescribed during other BMT programmes was mostly for musculo skeletal injuries, and comprised non-steroidal anti-inflammatory drugs (NSAID), acetaminophen and for severe cases, analgesics such as opioids for short-term pain relief (Beck *et al*. 2008:548; Hosey *et al.* 2008:385). The study participants who were able to recall their prescriptions, reported to have received mostly analgesics, NSAID, topical agents, muscle relaxants and glucocorticoid steroids. Participants who reported sustained injuries were requested to complete the remainder of the questionnaire (Questions 25-64).

4.5 THE INJURED PARTICIPANTS

Severe training injuries in the military environment were first described in 1855 amongst male Persian military recruits and are still considered prevalent among athletes and military recruits all over the world (Constantini *et al*. 2010:799). In this section of the instrument the intention of the researcher was to collect information on *when* injuries had occurred (Questions 25, 29) and the *response* of the recruit to either seek medical care or not, as well as the frequency of medical assistance (Questions 26-28). Of importance also was to identify allocated duty *restrictions* in order to determine the time lost during BMT (Questions 30-36, 38). The *type and site* of injuries (Question 37-41) sustained, as well as a description of the pain experienced (Questions 42-45) evidently contributed to an understanding of the injury profile during BMT period. Table 4.5 indicates the actual injured participants from each company. Injuries among the companies were fairly evenly distributed with the Echo company presenting with the highest percentage and the Bravo company with the lowest injury rate.

Table 4.5: Injury distributions between companies

BMT Companies	Total number of recruits	Completed Questionnaires per company	Injured Participants
A	N=125	n=99	26.32%, n=25
B	N=105	n=104	21.74%, n=20
C	N=128	n=102	24.14%, n=21
E	N=103	n=73	29.23%, n=19
F	N=104	Not completed	Not completed
Total	N=565	n=378	25.07%, n=85

TIME OF INJURY

Previous studies established that nearly half (48%) of musculoskeletal injuries (91%) occurred during duty hours while the remainder of the injuries (43%) were sustained during off duty time (Berg Rice *et al.* 2009:388). In this study 91.57% (n=75) of participants were injured during duty hours while 8.43% (n=7) were most likely injured during after-hour sporting activities. Findings indicate no significant difference in the time of injury between female and male, as portrayed in Figure 4.9.

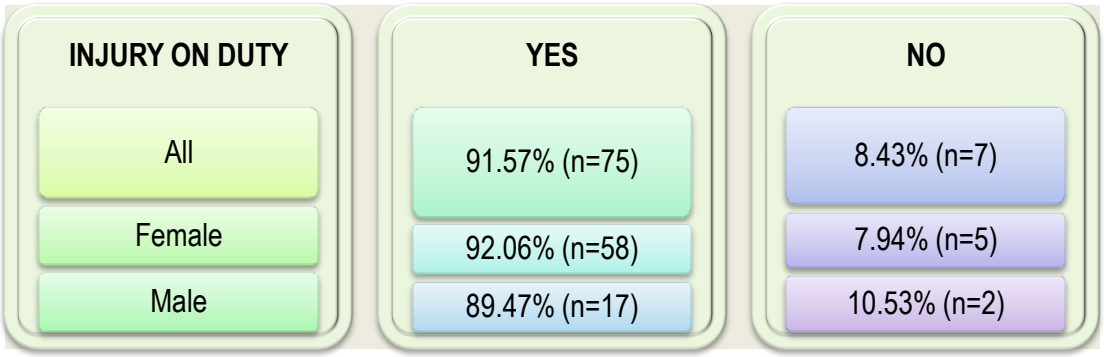


Figure 4.9: Percentage of on - and off-duty injuries by females and males

When investigating the specific week of injury within the BMT programme, a study conducted in South Africa by Jordaan and Schwellnus (1994:241) documented most injuries during week 1 to 3 as well as in week 9. Correspondingly, the majority of injuries in this study also occurred during week 3-4 and accounted for 22.86%

(n=8) of injuries, with the graph pattern then descending in nature, until week 13-14. These findings are in agreement with above-mentioned study and could possibly be associated with increased susceptibility to repetitive micro trauma and the repetitive nature of activities in the beginning of the BMT programme. Figure 4.10 Indicates the percentage of injuries encountered during specific weeks during BMT. However, only a small number of participants were able to recall the week of injury.

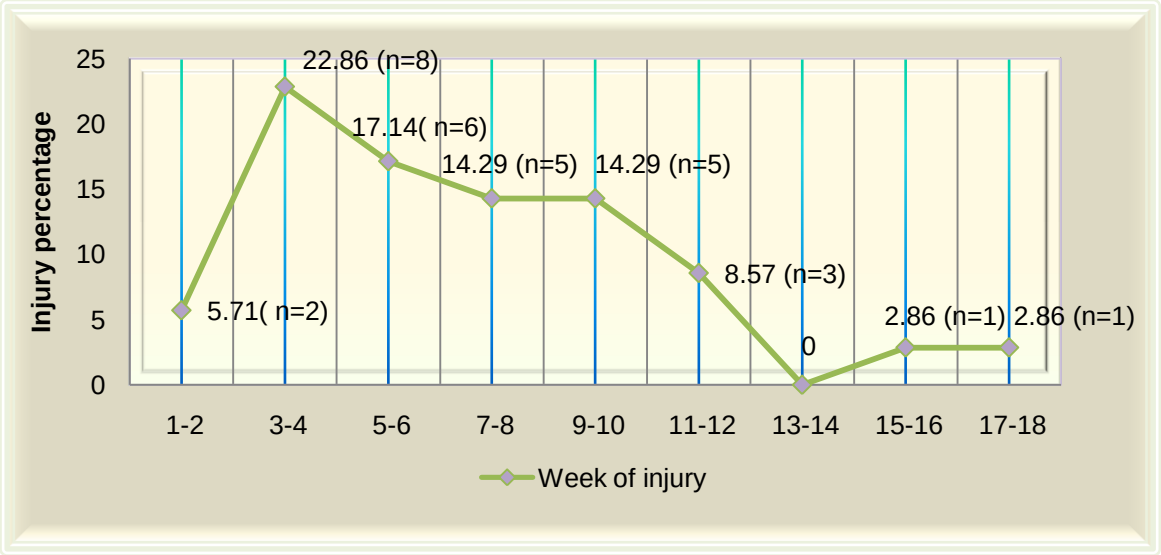


Figure 4.10: Percentage of injuries encountered during specific weeks during BMT

It was significant to observe that females sustained injuries almost throughout the BMT period, while the majority of male injuries occurred during week 3-4 with further incidents at the week 9-10 mark, during musketry training. Observe the gender percentage differences of injuries encountered by week in Figure 4.11.

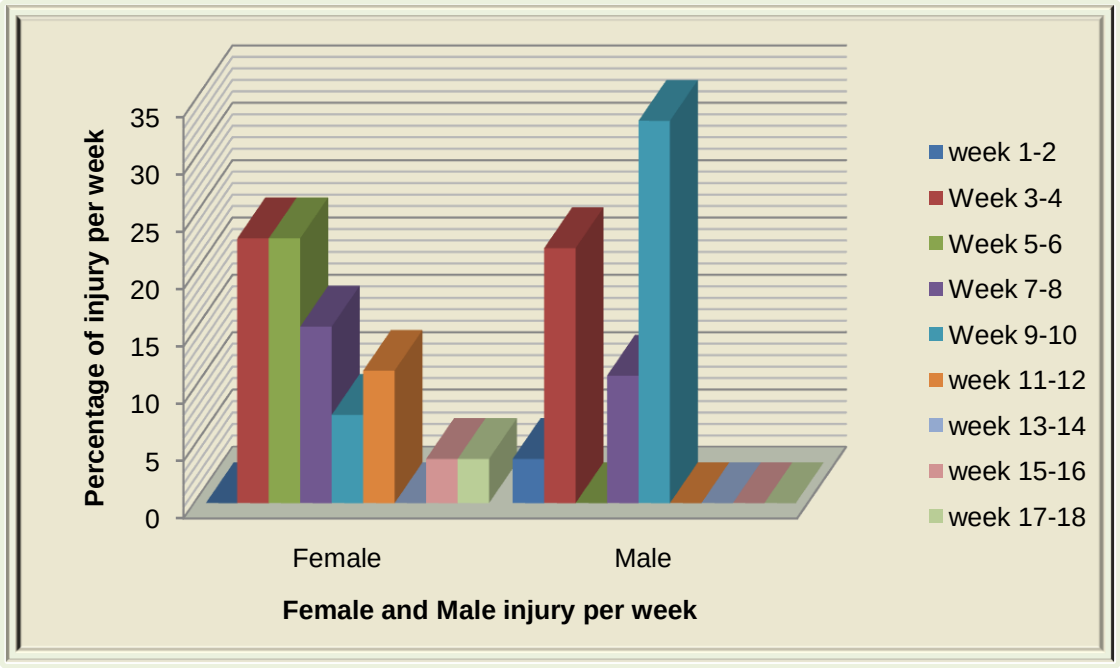


Figure 4.11: Percentage of injuries encountered per gender grouping during specific weeks of BMT

DUTY RECOMMENDATIONS

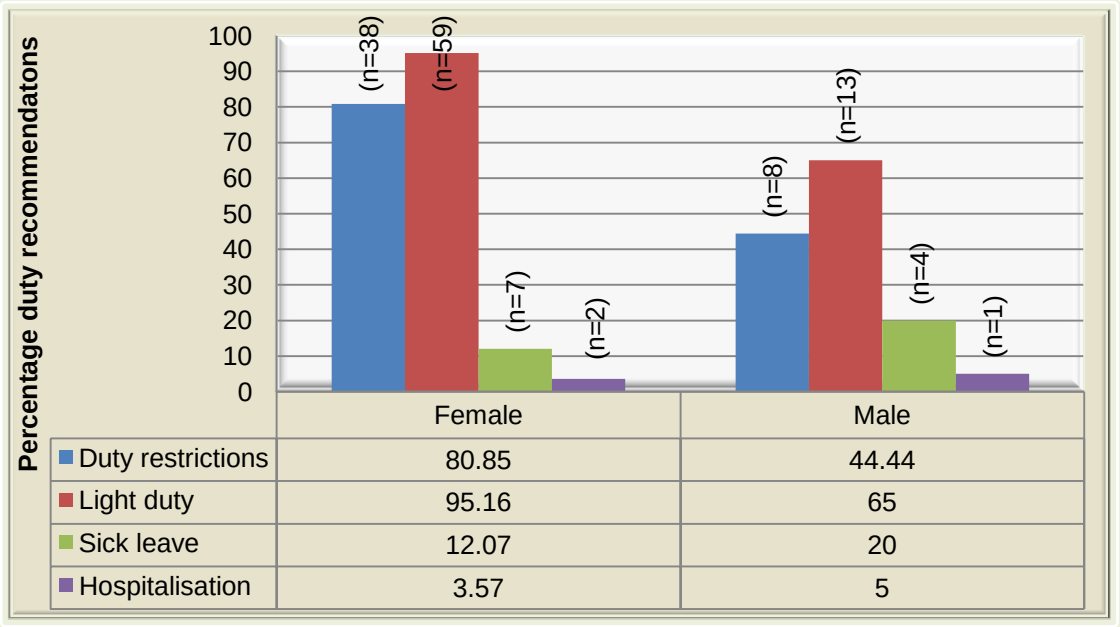
In this study 87.65% (n=71) of injured participants requested medical care; however, 12.35% (n=12) preferred not to seek medical care. The reasons ranged from the injury being perceived as minor and thus not requiring medical care, while some also indicated that they knew how to care for the injuries themselves, with one participant being apprehensive to *seek medical care* for the reason that he felt it might jeopardise his future.

TRAINING TIME LOST

During advanced individual training at Fort Sam Houston in the United States of America approximately 72% to 85% of soldiers were given duty restrictions for illness or injuries. Seventy one percent were given more than one week to recover for *a period of on* average 18 days. Duty restrictions were given for 72% of overuse injuries, of which 25% were musculoskeletal in nature and in particular, lower extremity injuries (Berg Rice *et al*. 2009:388).

Figure 4.12 depicts a summary of the percentage of *duty recommendations* amongst females and males in the study. These recommendations included duty

restrictions, light duty, sick leave, and hospitalisation of which a number of participants received more than one recommendation. In 80.85% of injury cases females were subjected to duty restrictions, in contrast with 44.44% for male participants. Most injured participants received light duty (87.95%, 73) recommendations. Time lost during training days is calculated as sick leave days (15) and hospitalization days (7), therefore 22 days were reported to be have been lost during BMT. A number of the participants were given both sick leave and were hospitalized, while only eight (9.41%) of the eighty-five injured participants did not receive any restrictions.



	Female	Male
Duty restrictions	80.85	44.44
Light duty	95.16	65
Sick leave	12.07	20
Hospitalisation	3.57	5

Figure 4.12: Percentage of duty recommendations females and males

TYPE AND SITE OF INJURIES

Musculo-skeletal conditions amongst military trainees in the United States of America are considered the most common type of injury, caused by physical training and operational activities (Pelham *et al*. 2008:425). While the Royal Marine recruits in the United Kingdom experienced training days lost predominantly owing to stress fractures, a systematic search of thirteen articles, furthermore described incidences of one in three recruits sustaining stress fractures during BMT, preventing them from continuing with their training (Zadpoor and Nikooyan 2011:23).

The type and site of injuries further complete the injury profile of recruits. Self-reported injury findings on the *type* of injuries sustained, indicated that the majority of participants sustained muscle or tendon injuries (41.19% n= 35), followed by fractures (12.94%, n=11), with stress fractures being in the minority (2.35%, n=2). Injury types were indicated as follows:

- Muscle / tendon 41.18% (n=35);
- fractures were reported for 12% (n=11);
- ligament injuries 9.41% (n=8);
- blister abrasions 9.41% (n=8);
- shin splints 7.06% (n=6);
- other injuries accounted for 11.9% (n=9);
- dislocations for 3.53% (n=3); and
- stress fractures for 2.32% (n=2).

With regard to these injuries, *medical referrals* reported involved 12.94% of the participants who had been sent for X-rays; 1.18% of these subsequently had been attended to by the orthopaedic specialists, and 1.18% had undergone physiotherapy and treatment by biokineticians respectively. The types of injuries are more comprehensively presented in Figure 4.13

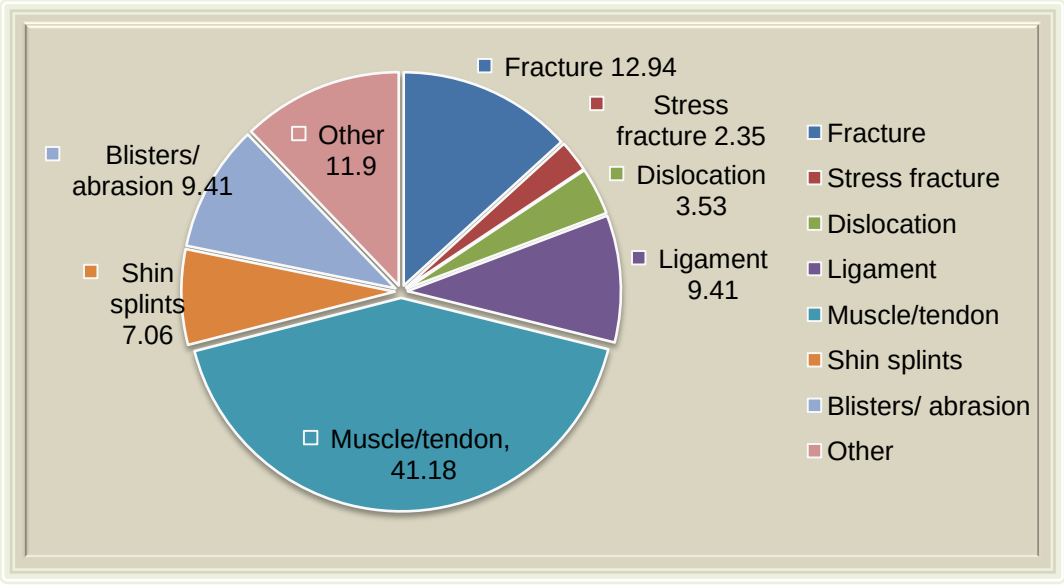


Figure 4.13: Percentage of injury types participants encountered during BMT

In a previous study the lower leg was identified as the most common *site* of injuries (Berg Rice *et al*. 2009:390). In this study, *injury sites* were divided into the *upper body* and *lower body,* and in general, most of the injuries also occurred in the lower legs with the knees in the highest percentage range with 40%, ankles 18.2% and the lower back with 9.41%. Figure 4.14 presents percentages of upper and lower body injury sites.

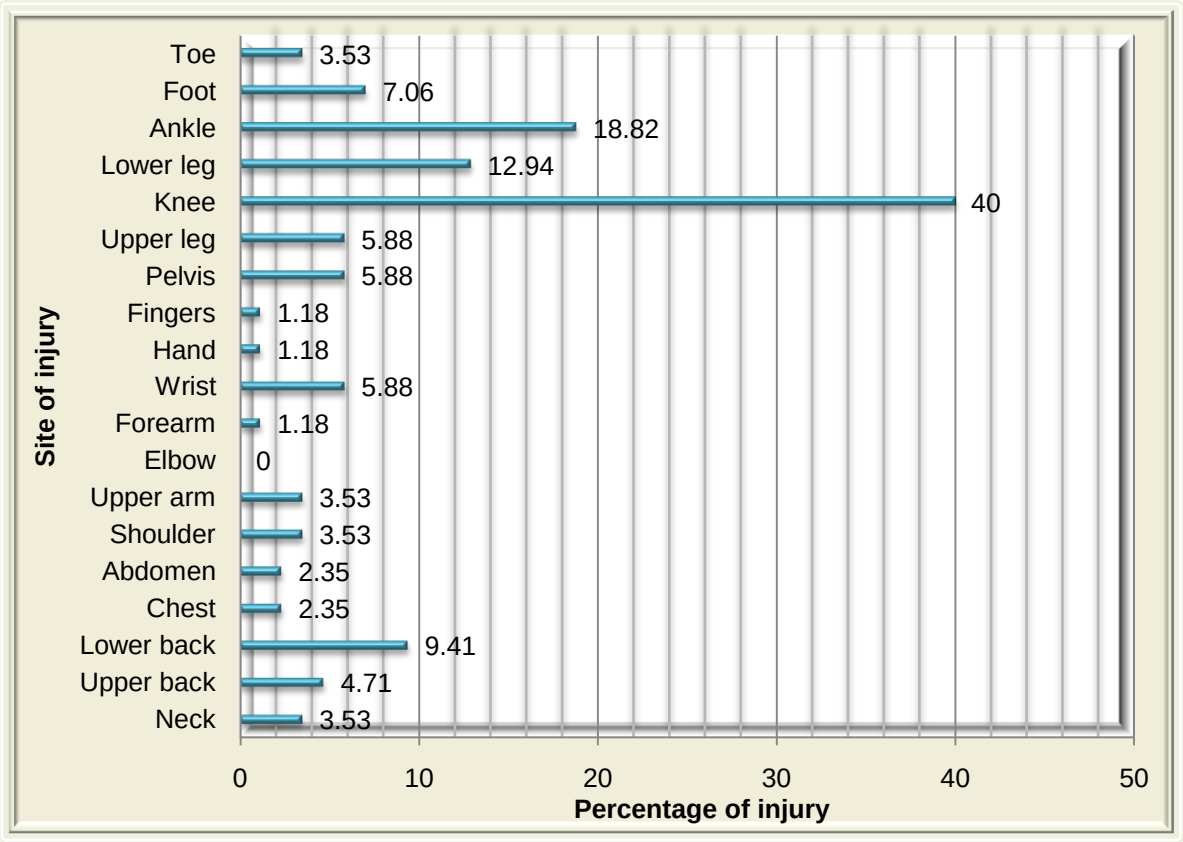


Figure 4.14: Percentages of injury sites upper and lower body

These injury sites were further divided into left and right sides of the body, and it was interesting to observe that the majority of participants were right-handed and the majority of injuries in the *upper body* were sustained on the *left side* while injuries sustained in the *lower body* mainly occurred on the *right* side with the exception of the upper leg and pelvis. Figure 4.15 portrays the percentage of injury sites on the left and right sides of the upper- and lower body. The researcher was unable to obtain relevant data to give an explanation for this finding.

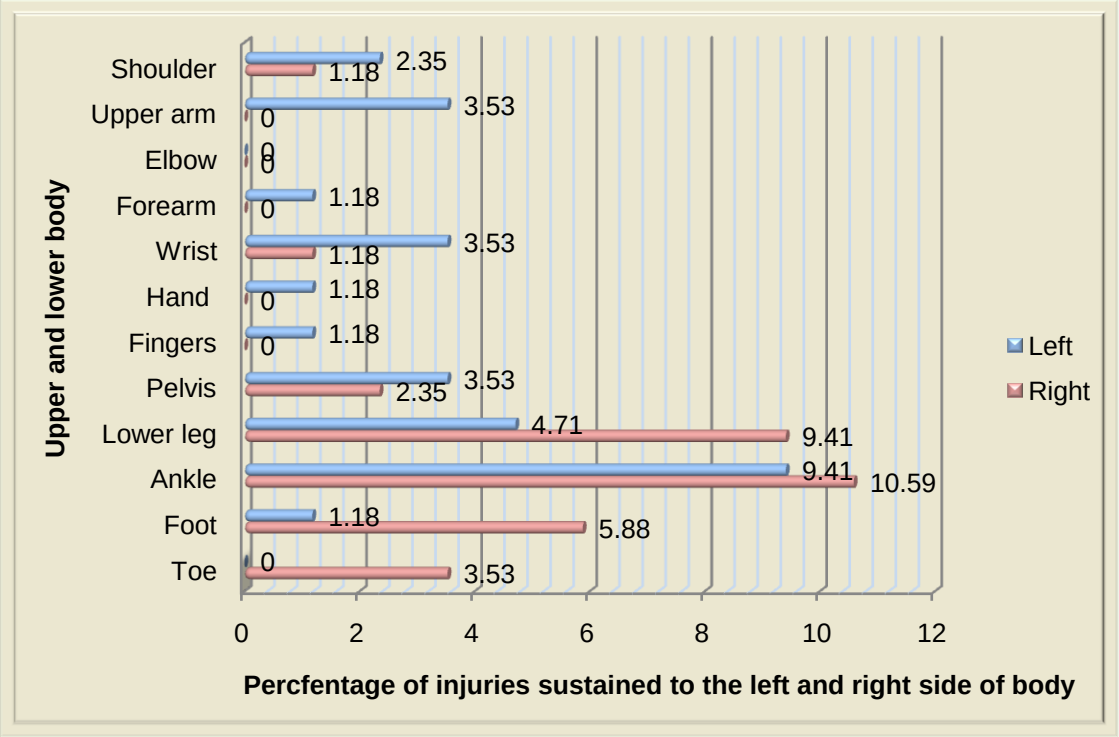


Figure 4.15: Percentage of injury sites upper and lower left and right

Gender differences and physical demands of British army recruit training concluded that injury risks were similar among men and women of the same level of aerobic fitness (Blacker *et al*. 2009:811). BMT groups in South Africa are also gender integrated and various differences such as body composition, muscle physiology and bone architecture could possibly pose a risk for injuries. Study results of the distribution of injuries amongst females were more evenly distributed with the knees (39.06%, n=25), lower leg (14.06%, n=9), and ankle (23.44%, n=15) being among the most frequent sites of injuries reported. Among male participants, however, injuries of the neck (10%, n=2), lower leg (15%, n=3) and knees (40%, n=8) occurred most often.

It is important to note here that some participants reported more than one injury per person, while a number of participants (n=27) sustained injuries to both sides of the body. A few participants (n=4) indicated that they had sustained injuries only on the left side, but did not indicate how many injuries they had sustained. Forty injuries had been sustained on the right side, while a number of injuries (n=14) were elsewhere on the body. Twenty seven participants indicated both right and left side

and that might be indicative of multiple injuries. Table 4.6 depicts the percentage of injuries by site and gender.

Table 4.6: Percentage of injuries by site and gender

INJURIES	FEMALE	MALE
Neck	1.56	10
Upper back	4.69	5
Lower back	7.81	15
Chest	0	5
Abdomen	3.13	5
Shoulder	3.13	5
Upper arm	4.69	0
Elbow	0	0
Forearm	1.56	0
Wrist	7.81	0
Hand	0	5
Fingers	1.56	0
Pelvis	7.81	0
Upper leg	6.25	5
Knee	39.06	40
Lower leg	14.06	10
Ankle	23.44	0
Foot	7.81	5
Toe	4.69	0

PAIN DESCRIPTION

Pain is an unpleasant protective mechanism that alerts the body with the purpose of preventing tissue damage (Brunkner and Khan 2012:41). Patients with overuse injuries frequently experience pain provoked upon exercising while it may also be alleviated during rest. Pain could worsen if no resting period is permitted, leading to

pain even during periods of rest (Itskoviz *et al*. 2011:56). In this study, however, *localized pain* was experienced by 72.97% of the injured participants, while the pain became worse for 74.36%, and gradually worsened for 46.15% of participants.

A study performed by Berg Rice *et al.* (2009:388) reported that a third of recruits (34%) experienced musculoskeletal symptoms severe enough to interfere with daily actives, while 6% said the pain was experienced most of the time, and 3% indicated interference all the time. In this study, however, half of the participants (49.33%) experienced pain *some time,* while a quarter (25.33%) had pain *most of the time.* Eight per cent of the group had injuries causing pain *all the time*. These findings on pain are thus more severe than those reported in the study of Berg Rice *et al.* (2009).

4.6 TRAINING PROGRAMME

The BMT programme is associated not only with *intrinsic* (Questions 46, 56, 57, 62) and *extrinsic* (Questions 49, 50, 51) risk factors relating to the *recruit* in the programme, but also aspects pertaining to *training activities* (Questions 47, 48, 52, 53). In addition a description is provided of how the participant perceived *environmental factors* (Questions 54, 55, 58-61) when the injury occurred. Lastly, supplementary concerns raised by participants will be reflected upon (Questions 63, 64).

THE PARTICIPANT WITHIN THE TRAINING PROGRAMME

Aetiological approaches deal with how and why injuries occur, also forming part of the biomechanics of injuries during a training programme. The strength of tissue varies according to its morphology such as bone, ligament and tendon, as well as with age and gender. Injury mechanism, in addition, could include intrinsic and extrinsic risk factors such as applied loads, often exceeding tissue strength and thus contributing to the incidence of injuries (Finch *et al.* 2011:65). During other relevant studies injuries occurred due to the fact that recruits were very exhausted, and inadequate recovery periods were allowed; the weight of equipment also played a

significant role in recruits being injured (Constantini *et al.* 2010:803; Ghani Zaden Hesar *et al.* 2009:1057; Hosey *et al*. 2008:385). Psychological factors were also found to have exacerbated injuries even further (Duran-Stanton and Kirk 2011:55; Hosey *et al*. 2008:383-384).

In the current study *intrinsic* risk factors of the recruit involved ratings of stress reported by 36.84% (n=28) of injured participants as having medium stress, while almost a third of females (32.76%, n=19) reported high stress levels compared to only 5.88% (n=1) of males considering their stress levels to have been high. Stress level differences between injured females and males were statistically significant (P=0.0034). Figure 4.16 indicates the difference in stress level ratings between males and females.

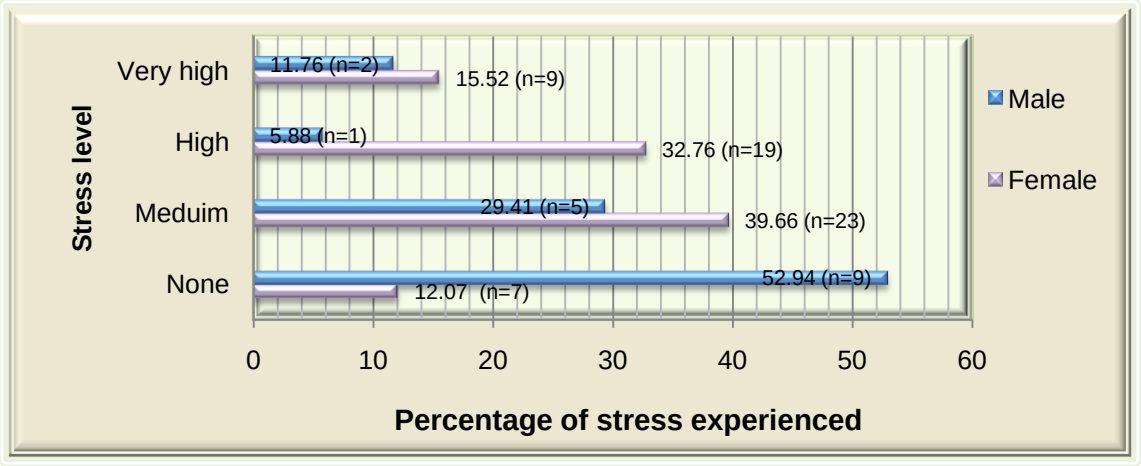


Figure 4.16: Percentages of stress experienced by injured female and male participants

Another intrinsic risk factor relating to *hydration* and *nutritional* status prior to the injury, established that 61.64% (n=45) of injured participants took enough *water* prior to the injury. Also, 77.78% (n= 56) of injured participants considered their *meals* to have been adequate on the day of injury. Therefore, a conclusion could be drawn that recruits were well nourished and hydrated at the time of injury. According to 60% (57.89, n=44) of the participants *warm-up* exercises were also sufficient to prevent injuries.

Extrinsic factors are easier modifiable than intrinsic factors and comprise utilizing modification of weight of gear and centre of gravity on external load (Constantini *et a*l. 2010:802). Lighter rifles and more closely fitted combat vests, as well as positioning gear closer to the body centre of gravity might have contributed to fewer stress fractures (Constantini *et al.* 2010:799). However, in this study, half (50.59%, n= 43) of injured participants reported that they *wore* neither a battle jacket, rifle nor a backpack at the time of injury - this might also be attributed to that fact that the above mentioned are mostly worn during the field phase and not that often during BMT. Most participants (62.35%, n=56) wearing a backpack reported that it *fitted* adequately. In addition, 72.09% (n=62) of injured participants wore *boots* at the time of injury and only 17.44% (n=15) wore running shoes. A number of injured participants (n=12) did not answer the question on footwear; however, no statistically significant contributing risk factor could be found in the wearing of footwear. Table 4.6 specifies the total injury types associated with footwear.

Table 4.6: Total of injury types associated with footwear

VARIABLES	Fracture	Stress fracture	Dislocation	Ligament	Muscle/ tendon	Shin splints	Blisters abrasions	Other
(n=)	***11***	***2***	***8***	***8***	***37***	***6***	***9***	***1***
Boots	7	2	5	7	26	5	4	0
Running shoes	2	0	1	1	5	1	0	0
Do not know	0	0	1	0	0	0	0	0
Other	1	0	0	0	0	0	2	0
None	0	0	0	0	0	0	1	0

TRAINING

Biomechanics and injuries are integrated, comprising aspects such as increased running intensity and change in terrain (Moen *et al.* 2009:538). Three leading causes for injuries were found to be physical training or exercising, marching, and outdoor activities, while group sport only accounted for 3% of injuries, and hand to hand combat for 2% (Berg Rice *et al.* 2009:390). In this study 45.83% (n=22) of

participants identified running as the activity that indeed contributed to their injury. However, the *activity of injury* for many (n=18) was unclear, possibly due to overuse. No statistically significant activity could be associated as a contributing risk factor for injuries seen in Table 4.7.

Table 4.7: Injuries and associated activities

VARIABLES	Fracture	Stress fracture	Dislocation	Ligament	Muscle Tendon	Shin splints	Blisters abrasions	Other
ACTIVITY								
Walking	3	0	2	0	4	1	1	0
Drilling	3	0	1	2	6	1	1	0
Jumping	1	0	0	1	1	0	1	0
Running	3	1	6	6	13	5	2	0
Long distance walk	1	1	1	1	5	1	0	0
Combat	2	0	1	0	6	0	1	0
Do not know	0	0	0	0	2	0	0	0
No specific activity	2	0	1	0	0	0	0	0

The most reported *mechanisms* of injuries were the process of falling (17.7%, n=15), as well as the fact that participants did not know what had happened when the injury occurred (14.1%, n=12). While lifting a heavy objects (12.9%, n=11) or obstacle course training (8.2%, n=7) were in the third and fourth places of identified mechanism of injury. Table 4.8 indicate contributing mechanism and total injuries reflected in percentage.

Table 4.8: Contributing mechanism and total injuries reflected in percentage

INJURY MECHANISM	Total Injuries (n)	Injury %
MECHANISM		
Stumbling	8	9.4
Falling	15	17.7
Obstacle	7	8.2
Lifting heavy objects	11	12.9
Fatigue	2	2.4
Dizzy	2	2.4
Do not know	12	14.1
Other	8	9.4

Table 4.9 depicts injuries as well as the associated mechanisms contributing to these injuries. Statistically significant mechanisms were associated with muscle and tendon injuries while doing obstacle course training. Furthermore, being tired could also have contributed to stress fractures.

Table 4.9: Number of Injuries and associated mechanisms

VARIABLES	Fracture	Stress fracture	Dislocation	Ligament	Muscle Tendon	Shin splints	Blisters abrasions	Other
MECHANISM								
Stumbling	0	0	1	1	4	2	0	0
Falling	2	1	0	3	7	1	1	0
Obstacle course	1	0	0	1	6	1	2	0
Lifting objects	2	0	1	1	6	0	2	0
Being tired	0	1	0	0	1	0	1	0
Dizzyness	0	0	0	0	0	0	1	0
Do not know	3	0	2	1	4	0	0	0
Other	1	0	1	0	3	0	2	0

4.7 ENVIRONMENTAL RISK FACTORS

When considering environmental risk factors, dehydration and fatigue were identified as contributing risk factors, especially weather conditions of 22 degrees Celsius and higher and humidity higher than 25%. Furthermore, heat stroke during strenuous physical exercise or sport events is common and contributes substantially to morbidity rates in the military, often due to the need for training regardless of warm climates (Brunkner and Khan 2012:146-149; Finch *et al.* 2011:65; Marom *et al.* 2011:219-225; Talley and O'Connor 2010:3-7; Hadid *et al.* 2008:329; Moran *et al*. 2008:636).

3 SAI Bn at Kimberley is situated at an altitude of approximately 1 230m above sea level and has hot, wet summers from December to February. Temperatures in January reach up to 32.3 degree Celsius (Kimberley South Africa 2013:online). Therefore, 41.57% (n=37) of participants considered the *weather* to have been very hot at the time of injury, while 42.70% (n=38) reported normal weather at the time of

the injury. Additionally, when looking at the wind and rain conditions, 85.92% (n=61) reported *no strong wind or rain* being present at the time of injury.

The gradient of the *terrain* did not play a significant role as 61.43% (n=43) of injured participants indicated that the terrain was *level* and not uphill or downhill at the time of injury. In addition, *changes* from grass to gravel also did not have an influence on injuries (46.05%, n=35). In fact, almost thirty per cent (29.73%, n=22) of participants reported the training *surface to have consisted of gravel,* while 25.68% could not recall the particular surface where the injury occurred. More than half of the participants (53.42%, n=39) reported that the injury happened in the *afternoon*, while the majority (63.38%, n=45) also reported that the injury occurred in the *middle of the training* programme; thus confirming results of enough warm up exercises in order to prevent injuries. The following associated factors were tested for the possibility of being contributing risk factors for injuries and were found to be statistically significant:

- Temperature and dislocations(P=0.0329);
- terrain and ligament injuries (P=0.0063);
- enough warm up and muscle and tendon injuries (P=0.0422);
- gradient and shin splints (P=0.0184); and
- warm-up and *other injuries* (P=0.0013) indicated by participants, such as a twisted ankle, swollen, painful feet, groin pain and sunburn to the feet.

Table 4.10 indicates statistically significant associations between environmental factors and injuries.

Table 4.10: Associations between environmental factors and number of injuries depicted in probability (P=) values

VARIABLES	Fracture	Stress fracture	Dislocation	Ligament	Muscle Tendon	Shin splints	Blisters abrasions	Other
ENVIRONMENT								
Temperature	1.0000	0.7143	0.0329	0.8363	0.9540	0.2506	0.7864	0.3103
Weather	0.7824	1.0000	1.0000	0.2423	0.8611	1.0000	0.6712	0.1396
Terrain	0.8926	1.0000	1.0000	0.0063	0.2177	0.1062	0.9575	0.2976
Gradient	0.9432	1.0000	0.1807	0.1280	0.2195	0.0175	0.6536	0.1451
Surface	0.6847	0.8829	0.7844	0.5964	0.6385	0.3458	0.7629	0.8945
Surface change	0.6521	0.5196	0.6315	0.6079	0.6385	0.1363	0.8482	0.0871
Warm-up	0.8792	1.0000	0.6456	0.2671	0.0422	0.5980	0.7495	0.0013
Programme	0.9405	1.0000	1.0000	0.3414	0.1893	0.6496	0.2385	0.3947

4.8 ADDITIONAL CONCERNS OF PARTICIPANTS

Participants verbalized concerns and fears regarding their own health, their medical condition, management of instructors, and medical treatment. A participant, in fact, said that he/she would like to continue with exercise after BMT. Figure 4.17 addresses comments of participants.

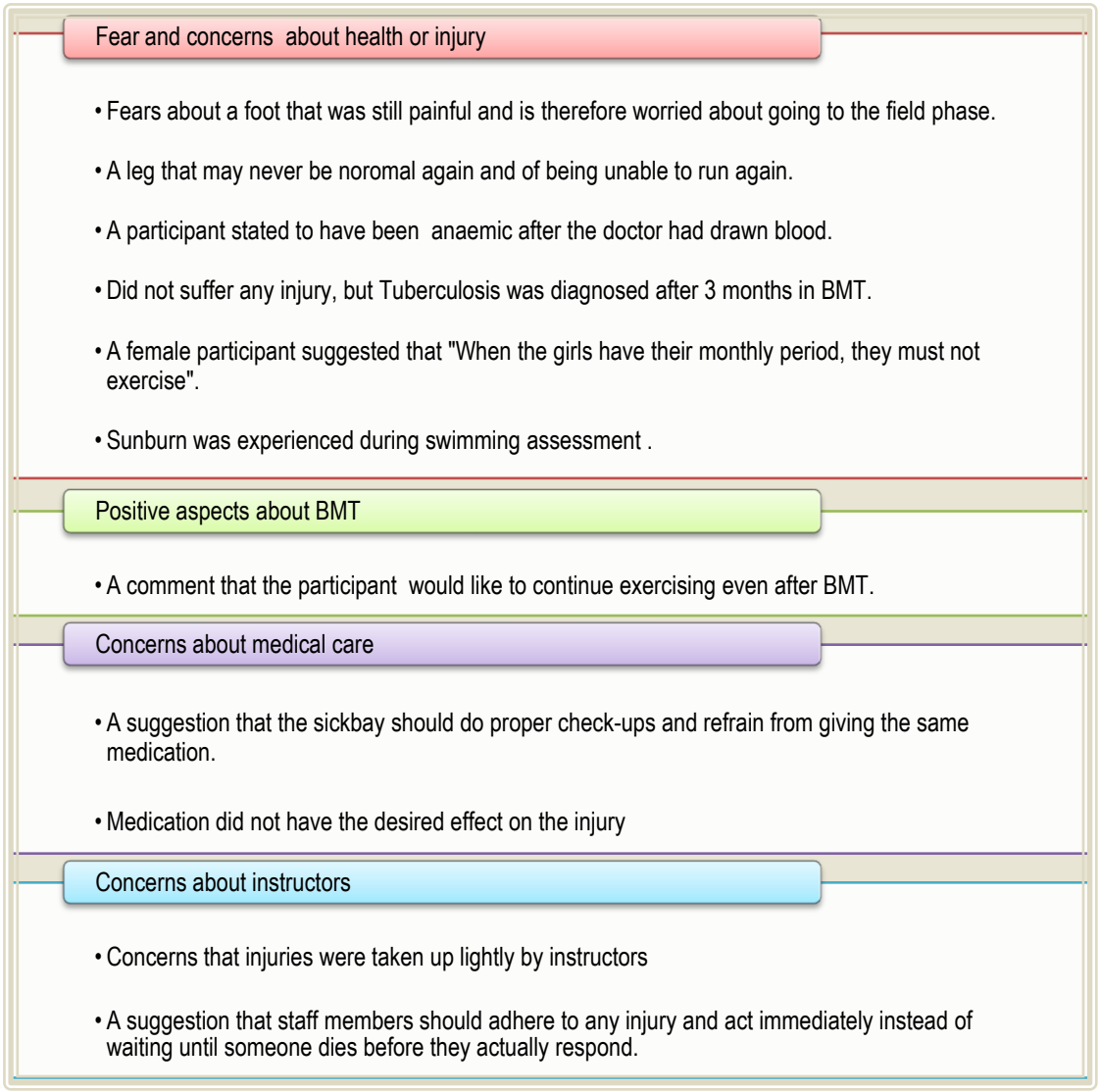


Figure 4.17: Additional concerns of participants

4.9 SUMMARY OF THE RESEARCH FINDINGS

Demographic aspects of participants during BMT were characterized by a population group comprising Black 83%, Coloured 13%, White 3% and Indian 1.3%. The BMT group comprised mostly Setswana-, Sesotho- and isiXhosa-speaking recruits. The gender distribution was: females 46.88% (n=173), and males 53.12% (n=196). Gender was found to be a statistically significant risk factor for injuries (P=2.351E-10), as 42% of females were injured while only 11% of males sustained injuries.

Participants had a mean body mass index of 24, while male participants were somewhat taller than South African mean measurements. The mean age for participants was 21.5 years. Their education level also exceeded that of the average South African with 34% of participants having obtained an educational level higher than a Grade 12 certificate.

Socio-economic data revealed that limited access to food prior to BMT by injured participants was not statistically significant (P=0.6460). Participants also had better access to food and better living standards than the average South African.

Medical history indicated that most participants did not smoke, but those who actually smoked were more at risk of being injured; however, in this study calculations did not reach statistical significance (P=0.6687). Unexpectedly, participants reported the use of medication such as haematinics, bronchodilators, antidepressants and tuberculostatics, contraindicated during BMT. The gynaecological history also revealed that almost half of female participants used contraception and that 65% had regular menstrual cycles; with almost 14% reporting amenorrhea. In this study the use of contraception (P=0.2282), amenorrhea (P=0.7208) as well as miscarriages (P=0.7182) and female smoking (P=0.354), were not found to be significant contributing risk factors for injuries.

The *sport and fitness history* indicated that nearly 40% of participants considered their fitness to be good; however, almost three quarters of female participants who considered their fitness to be a combination of poor and fair were injured, therefore, being unfit was considered a statistically significant contributing risk factor (P=0.0091). Having participated in sport (P=0.0296), and specifically weight–bearing types of sport (P=0.0023,*)* was found to have significantly reduced injuries.

Injury history was lower than expected with an injury rate of 25%, of which 19% were female and 6% were male participants. Medication prescribed comprised analgesics, topical agents, and NSAIDs. 92% of injuries reported had occurred while on duty and had happened mostly during weeks 3-4 of BMT. 88% of injured participants requested medical care, of which females were given 81% of duty

restrictions; therefore, gender played a statistically significant role in restricted duties (P=0.0063) and light duties (P=0.0015), as females were more injured than males, and required additional restrictions.

Injury type and site revealed that 41.2% of participants had muscle or tendon injuries along with 9.5% who reported ligament injuries. The prevalence of shin splints was lower than expected, with only 7% of participants diagnosed as such. 13% were referred for X-rays and 12% reported fractures, while only 2.3% reported to have had stress fractures. When looking at the *site* of injury, participants indicated the lower leg to have sustained most of the injuries, with 40% knee injuries and 19% ankle injuries. The majority of participants were right-handed and injuries from the head to the pelvis were mostly sustained on the left side, while injuries lower than the pelvis also generally were on the left-hand side. When describing *pain*, 72% of the participants experienced localized pain, and 47% indicated that the pain gradually had worsened. 8% of the participants reported that pain had interfered with their activities all the time.

Stress experienced by females during the *training programme* was statistically higher (p=0.0018) than stress experienced by male participants during BMT. Furthermore, females experiencing higher stress levels were more at risk of sustaining injuries (p=0.0034). Most participants reported to have had adequate *hydration and nutrition* prior to the injury, and 60% considered the *warm-up* to have been sufficient. Participants also considered their *back-pack* to be adequately fitted and did not consider *external loads* such as a rifle or back-pack to have had an impact on the injury. 72% reported that they were wearing boots at the time of injury.

Biomechanical aspects suggested that participants were unsure about the identified mechanism of injury; however, the majority reported to have sustained injuries such as muscle/tendon injuries and dislocations during an episode of running or falling during obstacle course training, while wearing boots. Responses regarding *environmental* risk factors indicated that 40% of the participants considered the weather to be very hot, but that no rain or wind played a role in the injury. The

terrain played a significant role in the prevalence of ligament injuries (P=0.0063); however, the areas were found to be *level and gravel surfaces.* These injuries also occurred most frequently in the *afternoon,* especially in the *middle of the training programme*.

4.10 CONCLUSION

An analysis of exercise-related injuries sustained during BMT in a changing military milieu will give a better understanding of the type of injuries to be expected. Therefore, this chapter outlined the intrinsic risk factors, consisting of a biographical and socio-economical profile, as well as the medical history of recruits, with additional information in the females' medical history. Extrinsic risk factors considered aspects of sport and fitness, injury history and in particular the injured participant. Subsequently a discussion of possible mechanisms of injuries included the training programme, environmental risk factors as well as additional concerns raised by participants. . An additional summary of research findings was included to obtain a better understanding of the entire contents of the data analysis chapter.

CHAPTER 5: RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapter reported on the data analysis, while the focus of this chapter will be on recommendations culminating from this study that could possibly be implemented within the military environment. These recommendations pertain to the establishment of task teams, having to substantiate and improve existing programmes. Aspects covered in the discussion are pre-enlistment fitness criteria for the BMT programme and recommendations regarding pre-enlistment fitness testing, as well as the implementation of remedial fitness training. Positive findings from BMT will be presented as well as the content of a balanced physical fitness programme (*cf.* Niebuhr *et al.* 2008:555). Implementation of injury control programmes for the purpose of optimizing supervision as well as health promotion programmes, and limitations and the value of this study will be discussed. Each recommendation will be linked to a risk factor addressed in the conceptual framework (Fig 1.2), as well as in the discussion of literature in Chapter 2. The risk factors being intrinsic and extrinsic risk factors, the BMT programme, as well as the injury profile of recruits.

5.2 TASK TEAMS

Two task teams at the *directorate policy making level* should be formed. Team A: A Military Health Services task team should be established, consisting of multi-professional directorates, namely Medicine; Nursing; Psychology and Ancillary Health. These directorates give feedback to the directorate: Planning, for implementation and co-ordination of recommendations. Team B should be formed from the directorates of the three other arms of service, namely Army; Air Force; and Navy. They should also be assisted by Occupational Health and Safety functionaries (OHS). These two task teams, A and B should re-evaluate, plan and give feedback to BMT units at ground level. Therefore, two other teams at *BMT unit level* should be formed in order to implement the policy recommendations. Team C,

should also be a multi-professional team, consisting of relevant Military Health Service members, such as a medical doctor, a RPN, physiotherapist, psychologist and a social worker. Team D, comprising relevant staff such as the Training Officer, Occupational Health and Safety (OHS) representative, and physical instructors should manage policy instructions on ground level for implementation.

Consequently collaboration on *directors' level* will be between task teams A and B, while on *BMT unit level*, teams C and D will work in partnership. Feedback mechanisms from *BMT level, however,* will go through their own directorates, for example, team C will give feedback to task team A and team D will give feedback to task team B.

Figure 5.1 represents the relevant communication channels within the SANDF structure for study purposes.

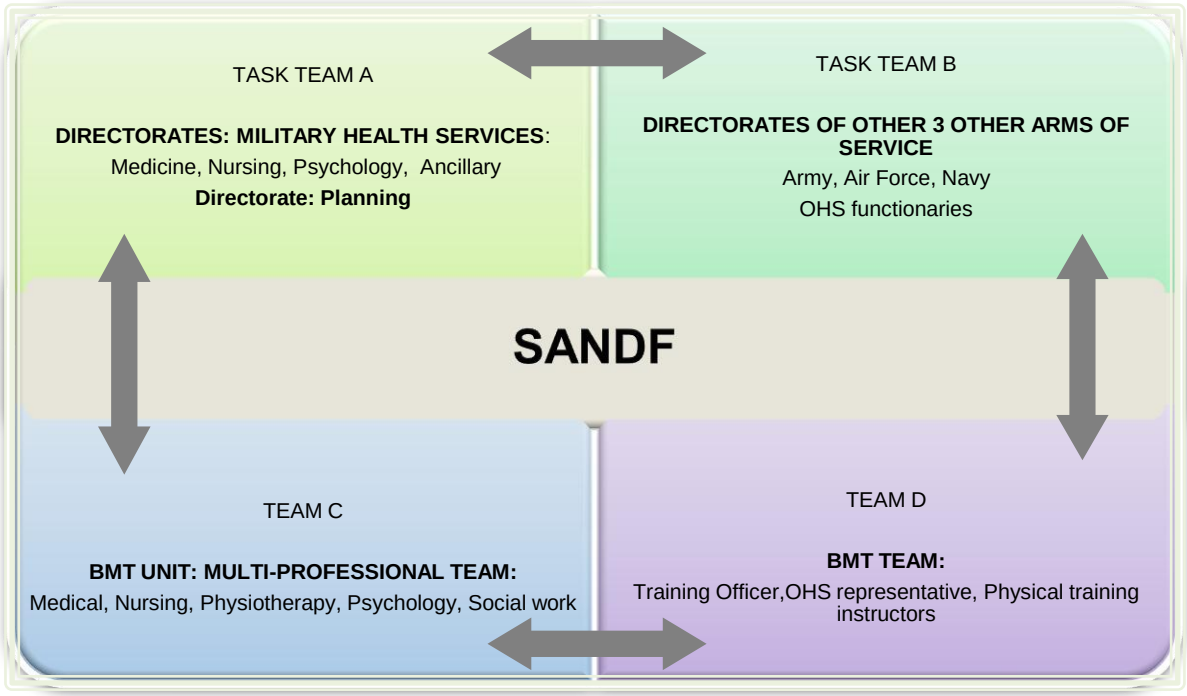


Figure 5.1: Proposed communication channels for study purposes

5.3. BMT FITNESS FINDINGS

Individuals most at risk of sustaining injuries during BMT were females with low levels of physical fitness, who did not participate in sport and, in particular, weight-bearing sport, prior to BMT. They also experienced high levels of stress.

5.3.1 BMT FITNESS RECOMMENDATIONS	Responsible	Intrinsic	Extrinsic	BMT	Injury
Priority should be given to develop and implement minimum *pre-enlistment* fitness standards for BMT, in order to reduce injury prevalence during the initial phase of weeks 3-4. Noteworthy information with regard to pre-enlistment fitness standards was obtained from a study conducted in the United States. These pre-enlistment tests had a significant impact on injury and attrition prediction of study participants. The tests included evaluations of *physical fitness, motivation and muscle endurance* (Niebuhr *et al.* 2008:555); • *physical fitness and motivation* were tested with a 5 minute step test of 120 beats per minute; or 30 up and down steps at 12 inches height for females, and 16 inches for male subjects. Heart rates were taken after one minute. To pass the test required continuation for 5 minutes at a set rate of 120 beats per minute (Niebuhr *et al.* 2008:555); • *muscular endurance* was tested through having participants doing as many push-ups as possible within one minute. To pass, males had to do at least 15 push-ups, and females 4 (Niebuhr *et al.* 2008:555);	A B C D	▲	▲	▲	▲

• all new recruits should undergo above-mentioned fitness evaluations or any other form of fitness evaluation already established as reliable and valid, before the BMT starts. Candidates who do not meet the required standards should not do physical training together with fit recruits, but be placed on a remedial fitness training programme; and • directorates (A and B) should re-evaluate already well-established remedial fitness training programmes, and implement (C and D) additional remedial fitness training programmes, in order to accommodate recruits that do not meet minimum fitness level requirements prior to BMT. Remedial intervention could decrease injury prevalence as well as possibly reduce stress levels of especially female recruits. Monthly feedback on injury prevalence and injury prevention should be given through to Directorate level (C to A and D to B).	A B C D	▲	▲	▲	▲

5.4 PHYSICAL TRAINING PROGRAMME: FINDINGS

Directorates should note that the injury rates in this study were lower than in mentioned reports of previous studies. Therefore, the training officers and OHS representatives of 3 SAI Bn should be recognised for the positive contributions to injury prevention already implemented. Positive aspects that should be maintained are related to the adequate hydration and nutrition reported by participants, as well as sufficient warm-up exercises prior to physical training. The programme actually motivated some of the recruits to continue with exercises after BMT. Furthermore, the majority of males did not experience high stress levels and also did not sustain as many injuries as females.

However, the majority of injuries were sustained during weeks 3-4, during the initial phase of BMT. Injured participants mostly sustained muscle/tendon, dislocation and ligament injuries of the lower legs. The identified training surface that contributed to injuries was level gravel training surfaces. The time of injury was mostly in the middle of the training programme and activities associated with injuries were obstacle course training. The identified mechanism of injury was running or falling, while recruits wore boots. Recommendation of a balanced training programme as described by Pelham *et al.* (2008:429) (see 5.3.1), as well as other recommendations should be considered in order to address these contributing risk factors more effectively.

5.4.1 PHYSICAL TRAINING PROGRAMME: RECOMMENDATIONS	Responsible	Intrinsic	Extrinsic	BMT	Injury
• Directorates (A and B) should re-evaluate and implement (C and D) rectifications on existing BMT programmes to further reduce injury prevalence; • the frequency and intensity of a programme should be progressive in nature and a training log should be maintained for evaluation purposes, especially during weeks 3-4, when most of the injuries occurred. The focus should be on increasing the total muscle strength training, and decreasing the total weekly running distance. In addition, comprehensive flexibility should be incorporated in each physical training session, as well as in warm-up and cool-down periods. Any increased workloads should also be progressive in nature and should include cross-training activities. A balanced schedule of high impact and low impact activities should always be maintained. Repetitive	A B C D	▲	▲	▲	▲

training should be limited, and variation should be incorporated in the physical fitness programme (Pelham *et al.* 2008:429); • non-weight bearing exercises such as swimming, should be introduced early in the training programme, in order to prevent overuse injuries, especially of the lower legs; • high intensity programmes should be planned to be implemented prior to days off, in order to allow time for rest and recovery; • running, marching and drilling should be practised on softer surfaces such as grass - where available; • boots should not be worn for extended periods, instead, focus on wearing training shoes, with the intention of giving recruits adequate time to adapt to the military environment and repetitive nature of drilling activities; • shorter recruits should consistently be positioned in the front and back of marching squads, with the intention of limiting the effect of stride length differences among males and females; and • obstacle course training should be introduced progressively, and particularly not in the initial phase of weeks 3-4 of BMT, with the purpose of reducing muscle/tendon, ligament and dislocation injuries.	A B C D	▲	▲	▲	▲

5.5 INJURY PREVENTION PROGRAMMES: FINDINGS

The purpose of improving existing injury presentation programmes during BMT is to optimize injury surveillance by collecting, processing, analysing, and disseminating injury results. These results should be accompanied by rectification plans and proof of implementation (C and D). Monthly reports should be sent through from the BMT

unit (C to A and D to B) to Directorates. These injury prevention programmes should be assessed and maintained, not to weaken existing training programmes, as might be the perception of role players working in this environment, but to enhance programme outcomes by reducing training-related injuries.

5.5.1 INJURY CONTROL PROGRAMMES: RECOMMENDATIONS	Responsible	Intrinsic	Extrinsic	BMT	Injury
• Feedback guidelines from monthly injury control meetings should be reviewed by Directorates (A and B) and should be provided from BMT unit level (C to A and D to B). Monthly meetings should be conducted at BMT unit level, attended by multi-professional healthcare personnel, OHS representatives of the BMT unit, physical training instructors, company representatives and the Training Officer of BMT units. The purpose of these meetings should be to discuss and strategize injury prevention challenges and solutions. Additionally, an environment of understanding of both health care practices and challenges regarding training requirements should be created, such as in-service training sessions, case study discussions, and presenting research on national platforms; and • continuous research should be motivated from Directorate level (A and B), performed by both the multi-professional team and BMT role players (C and D), in order to evaluate and implement injury prevention strategies contributing to a skilled, healthy and combat-ready soldier at the end of BMT.	A B C D	▲	▲	▲	▲

5.6 HEALTH PROMOTION PROGRAMME: FINDINGS

The purpose of these recommendations is to optimize existing health promotion programmes for both the recruit as well as the RPN who is the first line of treatment. Therefore, the Military Health Service task team (A) should also focus on broadening the first line of treatment rendered by the RPN working in a primary healthcare clinic. Further recommendations should be considered by task team A for establishment and implementation.

5.6.1 HEALTH PROMOTION PROGRAMME: RECOMMENDATIONS	Responsible	Intrinsic	Extrinsic	BMT	Injury
• Establishment of an onsite multi-professional approach, with a team consisting of a physiotherapist and a sports-medicine trained physician, to bridge the gap between primary care and orthopaedic surgeons, in order to make early and accurate diagnoses; • development of an algorithm to assist the RPN in having a high index of suspicion in order to make the correct diagnosis and giving optimal treatment and referral options; • continuous professional development programmes for RPNs should be evaluated and provision should be made to standardise information, as well as to distribute the latest information regarding musculo-skeletal injury management, treatment and prevention; • medical information sessions should be scheduled for recruits. These sessions could include information about the importance of early access to medical support, because a participant disclosed that he had been apprehensive to *seek medical care* for the	A C	▲	▲	▲	▲

reason that he felt his future could be jeopardised. Training should also include aspects relating to the changed roles of the female recruits within the military, and that no distinction could be made between male and female during BMT, considering that a participant proposed no training during their menstrual cycles; • psychological assessment of recruits should be proactive to identify contributing stress factors during BMT. Female recruits reported high stress levels that contributed to injury prevalence; • participants that smoked were more prone to injuries, therefore, the policy on smoking during BMT should be re-evaluated due to the subsequent effects of smoking, causing a lower bone density and also contributing to stress fractures; • a participant with low levels of serum iron was diagnosed during BMT at 3 SAI Bn. Another study conducted in the Israeli Defense Force by Merkel *et al*. (2008:691) established a 20% incidence of iron deficiency anaemia; this also is a contributing risk factor for stress fractures. Financial implications do not allow for all recruits to be tested for iron deficiency; however, a rapid haemoglobin screening should at least be considered by the Health Service task team (A) at the start of BMT; • sun block should be provided and application thereof should be enforced during training as well as during swimming activities in order to prevent sunburn; • a participant was diagnosed with tuberculosis of unknown origin, therefore, health promotion programmes should prioritize identification and prevention of communicable diseases transmission;	A B C D	▲	▲	▲	▲

and • a policy should indicate the management of recruits that are guilty of non-disclosure of the use of contra-indicated medication, such as was found in this study, because of the effect of bronchodilators and antidepressants, which might influence operational readiness and access to medication during deployment. •	A B C D	▲	▲	▲	▲

5.7 LIMITATIONS OF THE STUDY

Absolute numbers of injuries reported was likely to be under-reported; however, the types of injuries were equally represented between the companies. The findings could have been influenced by recall bias as participants could not always remember specific dates on which injuries had occurred. The study is susceptible to reporting bias as participants reported injury data according to their understanding. Some respondents did not respond to all the questions on the questionnaire; however, the limited number that was not completed, did not compromise reliability of the study.

Data were collected before the field phase, therefore, additional injuries could be anticipated when the field phase was included in the injury profile. However, study results confirmed that most injuries occurred during the initial phase when recruits were unfit and that injury rates were higher amongst female than among males therefore did not have an influence on the reliability of the injury profile.

5.8 VALUE OF THE STUDY

The value of this study lies in identifying the exercise-related injury profile of recruits during BMT. The elucidated information may benefit the entire SANDF in its planning and through the implementation of the recommendations for BMT

programmes. The findings of the study can also make a positive contribution in addressing health care needs and to nursing practice. Directorates from different Arms of Services will have the opportunity to work together as a team if the recommendations are accepted. Such a strengthened team approach will assist in improving the understanding of influencing risk factors recruits may be exposed to during BMT. An improved BMT programme may reduce risks in routine training activities and could assist the recruit in achieving fitness without additional injuries. There will also be an added financial benefit in saving on training time lost, and having a fit and combat-ready soldier at the end of BMT. Value could be added to Military Medical Services personnel, especially RPNs, from required feedback opportunities and the facilitation of professional development, which will also contribute to progression in training. These outcomes may elicit better appearance, combat readiness and ultimately improve organizational performance.

Photo 5.1 depicts the final clearing-out parade of BMT recruits prior to their deployment to other military units to start their military career.

Photo 5.1: The command: "Saluting to the right; Salute!", during the final clearing-out parade of BMT recruits (courtesy of 3 SAI Bn)

5.9 CONCLUSION

Recommendations have been presented to purposefully plan, implement, evaluate and manage BMT fitness and physical training programmes, injury control programmes, and health promotion programmes. These recommendations have a

bearing on intrinsic and extrinsic risk factors, as well as the BMT and the injury profile of recruits during BMT. The recommendations aimed to optimize training and minimize injuries without having to compromise BMT outcomes. The researcher further identified possible limitations in the study and how these limitations could have affected the study.

It is hoped that this study and the recommendations will positively contribute to the health and welfare of recruits during BMT, and even further in the SANDF.

"*Intellectuals solve problems: geniuses prevent them". Albert Einstein*

REFERENCES

Anand, A. and Kodikal, R.A.G. 2010. Subchondral stress fracture of femoral head in a healthy adult. *Indian Journal of Orthopaedics* 44(4):458-460, October.

Ataguba, J.E., Benatar, S.R., Doherty, J.E., Engelbrecht, M.C., Heunis, J.C., Janse van Rensburg, A.P., Kigozi, N.G., McIntyre, D.E., Pelser, A.J., Pretorius, E., Redelinghuys, N., Steyn, F., Van Rensburg, H.C.J. and Wouters, E. 2012. *Health and health care in South Africa.* Pretoria: Van Schaik Publishers.

Babbie, E. 2007. *The practice of social research*, 11th ed. Belmonth: Thomson Wadsworth.

Barker, J. 2010. *Evidence-based practice for nurses*, 1st ed. London: Sage Publications Ltd.

Baxter, M.L., Baycroft, C. and Baxter, G.D. 2011. Lower limb injuries in soldiers: feasibility of reduction through implementation of a novel orthotic screening protocol. *Military Medicine* 176(3):291-296, March.

Beck, B.R., Matheson, G.O., Bergman, G., Norling, T., Frederiscon, M., Hoffman, A.R. and Marcus, R. 2008. Do capacitively coupled electric fields accelerate tibial stress fracture healing? *American Orthopaedic Society for Sports Medicine* 36(3):545-552, January.

Bell, J. 2010. *Doing your research project. A guide for first-time researchers in education, health and social science*, 5th ed. Berkshire: Open University Press.

Berg Rice, V.J., Mays, M.Z. and Gable, C. 2009. Self-reported health status of students in-processing into military medical advanced individual training. *IOS Press* 34:378-400.

Bickley, L.S. and Szilagyi, P.G. 2009. *Bates' Guide to Physical Examination and History taking*. Philadelphia: Lippincott Williams & Wilkins.

Blacker, S.D., Wilkinson, D.M., Bilzon, J.L.J. and Rayson, M.P. 2008. Risk factors for training injuries among British army recruits. *Military Medicine* 173(3):278-268, March.

Blacker, S.D., Wilkinson, D.M. and Rayson, M.P. 2009. Gender Differences in the Physical Demands of British Army Recruit Training. *Military Medicine* 17(8):811-816, August.

Blake, C.G. and Ross, M.D. 2008. Femoral neck fracture in a military trainee. *Journal of Orthopaedic & Sports Physical Therapy* 38(9):578, September.

Blaxter, L., Hughes, C. and Tight, M. 2006 *How to research*, 3rd ed. Buckingham: Open University Press.

Botma, Y., Greef, M., Mulaudzi, M. and Wright, S.C.D. 2010. *Research in health sciences*, 1st ed. Cape Town: Pearson.

Brink, H. 2006. *Fundamentals of research methodology for health care professionals* 2nd ed. Cape Town: Juta.

Brunkner, P. and Khan, K. 2012. *Clinical sports medicine*, 4th ed. China: McGraw-Hill Australia Pty Ltd.

Burns, N. and Grove, S.K. 2011. *Understanding nursing research: building an evidence-based practice*, 5th ed. Maryland Heights: Elsevier Saunders.

Burton, N., Brundrett, M. and Jones, M. 2008. *Doing your education research project*. Los Angeles: Sage Publications Ltd.

Cambridge 2008. *Cambridge advanced learner's dictionary*, 3rd ed. New York: Cambridge University Press.

Campbell, S.E. and Fajardo, R.S. 2008. Imaging of stress injuries of the pelvis. *Seminars in Musculoskeletal Radiology* 12(1):62-71, March.

Chiet, K.E. 2009. Physical therapy for pelvic stress fractures in a female military recruit: a case study. *Orthopaedic Physical Therapy Practice* 21(2):22-27.

Constantini, N., Finestone, A.S., Hod, N., Shub,I., Heinemann, S., Foldes, A.J. and Mann, G. 2010. Equipment modification is associated with fewer stress fractures in female Israel border police recruits. *Military Medicine* 175 (10):799-804, October.

De Vos, A.S., Strydom, H., Fouche, C.B. and Delport, C.S.L. 2011. *Research at grass roots for the social sciences and human service professions*, 4th ed. Pretoria: Van Schaik.

Dennill, K. and Rendall-Mkosi, K. 2012. *Primary health care in Southern Africa: a comprehensive approach*, 3rd ed. Cape Town: Oxford University Press Southern Africa (Pty) Ltd.

Department of Defence. 2006. SA Army order on career management. *Department of Defence (SA ARMY)*, SA ARMY/C DIR ARMY CORP SVC/DIR ARMY HR/R/308/01/05 (104/31/2/B):B1-B26, March.

Department of Defence. 2008. Transformation management in the DOD. *Department of Defence Directive*, (CHR/CDTM/106/30/1/P):1-4, November.

Department of Defence. 2009. 'On the health classification and deployability of SANDF members witht HIV and AIDS', *Department of Defence Directive*, DODD/SG/00006/2009 (SG/R/104/11/6/9/P):A1-12, November.

Department of Defence. 2011. Defence secretariat strategic plan for the fiscal years 2011/12, (2015/16):1-53, March.

Department of Defence. 2013. *Department of Defense intranet homepage 3 SA Infantry Battalion* [Online]. Available: htt://trgfmn.army.mil.za:8080/3SATrgRegt/BMT [Accessed on 01/02/2013].

Disabled World. 2008. *Height chart of men and women in different countries*, 13 October [Online], Available: http:www.disabledworld.com [Accessed on 27/04/2013].

Duran-Stanton, A.M. and Kirk, K.L. 2011. "March Fractures" on a female military recruit. *Military Medicine* 176(1):53-55, January.

Endacott, R., Jevon, P. and Cooper, S. 2009. *Clinical nursing skills: core and advanced*. Italy: Oxford University Press.

Finch, C.F., Ullah, S. and McIntosh, A.S. 2011. Combining epidemiology and biomechanics in sports injury prevention research: a new approach for selecting suitable controls. *Sports Medicine* 41(1):59-72.

Finestone, A. and Milgrom, C. 2008. How stress fracture incidence was lowered in the Israeli army: a 25-year struggle. *Medicine & Science in Sports & Exercise*, pp. 623-629.

Galit, N., Tamar, B., Moshe, S., Yehezekel, T. and Israel, D. 2008. Ramus pubis insufficiency fractures after total hip arthroplasty: Physiological and biomechanical considerations. *Journal of Musculoskeletal Research* 11:181-184, October.

Ghani Zadeh Hesar, N., Van Ginckel, A., Cools, A., Peersman, W., Roosen, P., De Clercq, D. and Witvrouw, E. 2009. A prospective study on gait-related

intrinsic risk factors for lower leg overuse injuries. *British Journal of Sports Medicine* 43:1057-1061.

Gomm, R. 2009. *Key concepts in social research methods*. New York: Palgrave MacMillan.

Gordon, N.F., Hugo, E.P. and Cilliers, J.F. 1986. The South African Defence Force physical training programme. Part 3. Exertion-related injuries sustained at a SADF basic training centre. *SAMJ* 69:491-494, April.

Grotewold, S. 2013. *Competitor your online source for running*, 01 February, [Online]. Available: http://running.competitor.com/2012/04/injury-prevention [Accessed on 01/05/2013].

Hadid, A., Evans, R.K., Yanovich, R., Luria, O. and Moran, D.S. 2008. Motivation, cohesion, satisfaction, and their relation to stress fracture among female military recruits. *European Journal of Applied Physiology* 104:329-335, April.

Havenetidis, K and Paxinos, T. 2011. Risk factors for musculoskeletal injuries among Greek army officer cadets undergoing basic combat training. *Military Medicine* 176(10):1111-1116, October.

Health posturology. n.d. [Online]. Available: http://www.footclinic.it/en_posturologia.asp?print=1 [Accessed on 01/05/2013].

Hetsroni, I. and Mann, G. 2009. Fibula stress fractures: A treatment review. *Operative Techniques in Sports Medicine* 17(2):112-114, April.

Hofstee, E. 2006. *Constructing a good dissertation: a practical guide to finishing a master's, MBA or PhD on schedule*. Johannesburg: EPE.

Hosey, R.G., Fernandez, M.F. and Johnson, D.L. 2008. Evaluation and management of stress fractures of the pelvis and sacrum. *Sports Medicine Update* 31(4):383-385, April.

Itskoviz, D., Marom, T. and Ostfeld, I.I. 2011. Trends of stress fracture prevalence among Israeli Defense Forces basic trainees. *Military Medicine* 176(1):56-59, January.

Jordaan, G. and Schwellnus, M.P. 1994. The incidence of overuse injuries in military recruits during basic military training. *Military Medicine* 159(6):421-426, June.

Joy, S.M. 2007. Predicting lower extremity stress fractures in young women recruited into the Marine Corps. *Clinical Journal of Sport Medicine* 17(1):80-81, January.

Joy, E.A., Van Hala, S. and Cooper, L. 2009. Health-related concerns of the female athlete: a lifespan approach. *American Family Physician* 6:489-495, March.

Kimberley South Africa. 2013. *The Kimberley Climate*, [Online]. Available: http://www.bdb.co.za/kimberley/climate.htm [Accessed on 10/05/2013].

Lappe, J., Cullen, D., Haynatzki, G., Recker, R., Ahlf, R. and Thomsoon, K. 2008. Calcium and vitamin D supplementation decreases incidence of stress fractures in female navy recruits. *Journal of Bone and Mineral Research* 23(5):741-749, May.

LoBiondo-Wood, G. and Harber, J. 2010. *Nursing research methods and critical appraisal for evidence-bases practice*, 7th ed. China: Mosby Elsevier.

Lowe, W. n.d. *Dr Walt Lowe*, [Online]. Available: http://drwaltlowe.com/acl-injury/ [Accessed on 01/08/ 2013].

Maffulli, N., Longo, U.G. and Denaro, V. 2009. Femoral neck stress Fractures. *Operative Techniques in Sport Medicine*, pp. 90-93, June.

Marieb, E.N. and Hoehn, K. 2010. Human anatomy & physiology in *human anatomy & physiology*, 8th ed. San Francisco: Pearson Benjamin Cummings.

Marom, T., Itskoviz, D., Lavon, H. and Ostfeld, I. 2011. Acute care for exercise-induced hyperthermia to avoid adverse outcome from exertion heat stroke. *Journal of sport rehabilitation* (20):219-227.

Mash, B., Blitz, J., Kitshoff, D. and Naudé, S. 2010. *South African clinical nurse practitioner's manual*. Pretoria: Van Schaik Publishers.

Matava, J.J. 2008. Overuse Injuries. *American Orthopaedic Society for Sports Medicine*, pp. 1-2.

McGraw, L., Pickering, M.A., Ohlson, C. and Hammermeister, J. 2012. The influence of mental skills on motivation and psychosocial characteristics. *Military Medicine* 177(1):77-84, January.

Melnyk, B.M. and Fineout-Overholt, E. 2005. *Evidence-based practice in nursing & healthcare: a guide to best practice.* Philadelphia: Lippincott Williams & Wilkins.

Merkel, D., Moran, D.S., Yanovich, R., Evans, R.K., Finestone, A.S., Constantini, N. and Israeli, E. 2008. The association between hematological and inflammatory factors and stress fractures among female military recruits. *Medicine & Science in Sports & Exercise*, pp. 691-697.

Moen, M.J., Tol, J.L., Weir, A., Steunebrink, M. and De Winter, T.C. 2009. Medial tibial stress syndrome. *Sports Medicine* 39(7):523-546.

Molloy, J.M., Feltwell, D.N., Scott, S.J. and Niebuhr, D.W. 2012. Physical training injuries and interventions for military recruits. *Military Medicine* 177(5):553-558, May.

Moran, D.S., Israeli, E., Evans, R.K., Yanovich, R., Constantini, N., Shabshin, N., Merkel, D., Luria, O., Erlich, T., Laor, A. and Finestone, A. 2008. Prediction model for stress fracture in young female recruits during basic training. *Medicine & Science in Sport & Exercise*, pp. 636-644.

Moretti, B., Notarnicola, A., Garofalo, R., Moretti, L., Patella, S., Marlinghaus, E. and Patella, V. 2009. Subchondral stress fracture of femoral head in a healthy adult. I*ndian Journal of Orthopaedics* 44(4):458-460, October.

Moule, P. and Goodman, M. 2009. *Nursing research: an introduction*. London: Sage.

Muijs, D. 2004. *Doing quantitative research in education with SPSS*. London: SAGE Publications Ltd.

Nichols, D.L., Sanborn, C.F. and Essery E.V. 2007. Bone density and young athletic women. *Sports Medicine* 37(11):1001-1014.

Niebuhr, D.W., Scott, C.T., Powers, T.E., Li, Y., Han, W., Millikan, A.M. and Krauss, M.R. 2008. Assessment of recruit motivation and strength study: Preaccession physical fitness assessment predicts early attrition. *Military Medicine* 173 (6):555-561, June.

Opie, C. 2004. *Doing educational research*. London: Sage Publications Ltd.

Patel, D.S., Roth, M. and Kapil, N. 2011. Stress fractures: Diagnosis, treatment, and prevention. *American Family Physician* 83(1):39-46, January.

Pelham, T.W., Holt, L.E. and White, H. 2008. Physical training of combat diving candidates: Implications for the prevention of musculoskeletal injuries. *IOS Press and the authors* 30:423-431.

Pfizer. 2012. *My time to start*, [Online] Available: http://www.pfizer.co.za [Accessed on 27/04/2013].

Polit, D.F. and Beck, C.T. 2006. *Essentials of nursing research methods, appraisal, and utilization*, 6th ed. Crawfordsville: Lippincott Williams & Wilkins.

Polit, D.F. and Beck, C.T. 2008. *Nursing research: generating and assessing evidence for nursing practice*, 8th ed. Philadelphia: Lippincott Williams & Wilkins.

Polit, D.F. and Beck, C.T. 2012. *Nursing research: generating and assessing evidence for nursing practice*. China: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Quinn, E. 2011. *Bruise (Contusion): Causes and Treatment*, 15 June [Online]. Available: http://sporinjurybulletin.com/archive/bone-bruises [Accessed on 10/02/2013].

Republic of South Africa. 2006. Nursing Act: Act No.33 of 2005 *Government Gazette* 491(28883):1-45, May.

Schaffer, R.A., Rauh, M.J., Brodine, S.K. Trone, D.W. and Macera, C.A. 2006. Predictors of stress fracture susceptibility in young fermale recruits. *American Journal of Sports Medicine* 34(1):108-115, January.

South Africa. 1996. *The Constitution of the Republic of South Africa*, 4th ed. Cape Town: Juta Law.

South Africa Info. n.d. *The Languages of South Africa* [Online]. Available: http://www.southafrica.info/about/people/language.htm#.Ue8MadJHLfI [Accessed on 03/02/2013].

Statistics South Africa. 2012. General household survey 2011. *Statistics South Africa*, pp. 1-160.

Talley, N.J. and O'Connor, S. 2010. *Clinical examination: A systematic guide to physical diagnosis*, 6th ed. China: Churchill Livingston Elsevier.

Tredoux, C. and Durrheim, K. 2010. *Numbers, hypotheses & conclusions: a course in Statistics for the Social Sciences*. Lansdowne: UCT Press.

Uys, H.H.M. and Basson, A.A. 2005. *Research methodology in nursing*, 10th ed. Cape Town: Creda Communications.

Van de Venter, J. 2004. Process and procedures on physical training in the DOD, *Joint Defence Publication*, pp. 1-20, October.

Vanderbilt Athletics. 2010. *Vanderbilt Sports Medicine*, [Online] Available: http://vanderbiltathletictraining.blogspot.com/2010/10/shin-splints-defined.html [02 May 2013].

Vasyli Medical. 2011. *Vasyli Medical*, [Online] Available: http://www.vasylimedical.com/resources/biomechanics_gait_cycle.html [Accessed on 01/05/2013].

Viljoen, M.J. and Sibiya, N. 2009. *History taking and physical examination*, 2nd ed. Cape Town: Pearson Education.

Warden, S.J., Creaby, M.W., Bryant, A.L. and Crossley, K.M. 2007. Stress fracture risk factors in female football players and their clinical implications. *British Journal of Sports Medicine* 41(1):38-43, August.

Waugh, A. & Grant, A. 2010. *Ross & Wilson's anatomy and physiology in health and illness.* Edinburgh: Churchill Livingstone Elsevier.

Zadpoor, A.A. and Nikooyan, A.A. 2011. The relationship between lower-extremity stress fractures and the ground reaction force: A systematic review. *Clinical Biomechanics* 26:23-28.

ADDENDUM A: APPROVAL: AMHU FS OFFICER COMMANDING

RESTRICTED

AMHUFS/R/405/1

Telephone: 051 402 2034
Enquiries: Capt E. vd Westhuizen

Health Centre Bloemfontein
Private Bag x20503
Bloemfontein
9300

// January 2012

AUTHORIZATION TO COORDINATE RESEARCH IN 3 SAI BN

1. I hereby request authorization to visit 3 SAI Bn in order to make arrangements to conduct research in exercise related injuries during basic training. The study was planned for Tempe but all the recruits were relocated at 3 SAI Bn for 2012.

2. Research will contribute to a better understanding of the injury profile in order to make informed decisions for future recommendations on injury prevention and health promotion during basic training.

3. A 16% prevalence in pelvic stress fractures occurred amongst female recruits during 2010 basic training in Tempe with subsequent light duty for six months.

4. The research is essential for the DOD since an injury sustained during basic training is considered an injury on duty and has to be reported not only to the compensation commissioner but also impacts negatively on combat readiness and medical expenses.

5. A self reported injury questionnaire will be completed by the recruits at the end of basic training. Arrangements with the medical personnel as well as Unit Commanders' have to be discussed to conduct the study.

(E.VD WESTHUIZEN)
ACT HEALTH PROMOTION MANAGER: CAPT

RECOMMENDATION BY COMMANDING OFFICER

(G.Z. ERLANK)
COMMANDING OFFICER AREA MILITARY HEALTH UNIT FREE STATE: COL

World-class Clinical Service
RESTRICTED

ADDENDUM B: APPROVAL: ETHICS COMMITTEE OF THE FACULTY OF HEALTH SCIENCES

Research Division
Internal Post Box G40
☎(051) 4052812
Fax (051) 4444359

E-mail address: StraussHS@ufs.ac.za

Ms H Strauss/hv

2012-03-07

REC Reference nr 230408-011
IRB nr 00006240

MS/CAPTAIN E VAN DER WESTHUIZEN
c/o DR M REID
SCHOOL OF NURSING
UFS

Dear Ms/Captain

ECUFS NR 32/2012
MRS/CAPTAIN E VAN DER WESTHUIZEN **DEPT OF PRIMARY HEALTH CARE NURSING IN THE SA MILITARY HEALTH SERVICES AT THE SA NATIONAL DEFENCE FORCE**
PROJECT TITLE: EXERCISE-RELATED INJURY PROFILE AMONGST RECRUITS DURING BASIC MILITARY TRAINING IN 3 SOUTH AFRICAN INFANTRY BATTALION AT KIMBERLEY

- You are hereby kindly informed that the Ethics Committee approved the above project at the meeting held on 6 March 2012.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.
- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

For CHAIR: ETHICS COMMITTEE
cc Ms/Captain E van der Westhuizen

ADDENDUM C: APPROVAL: 1 MILITARY HOSPITAL RESEARCH ETHICS COMMITTEE

RESTRICTED

1MH/302/6

Tel: 012 314 0487
Facsimile: 012 314 0623
Enquiries: Prof / Lt Col
M.K. Baker

1 Military Hospital
Private Bag X1026
Thaba Tshwane
0143
28 September 2012

CLINICAL TRIAL APPROVAL: "EXERCISE-RELATED INJURY PROFILE AMONGST RECRUITS DURING BASIC MILITARY TRAINING IN 3 SOUTH AFRICAN INFANTRY BATTALION AT KIMBERLEY"

1. The 1 Military Hospital Research Ethics Committee (1MHREC), adhering to GCP/ICH and SA Clinical Trial guidelines, evaluated the above-mentioned protocol and additional documents.

2. The following members approved the study:

   a. Lt Col M.K. Baker: Neurologist, male, chairman 1 MHREC.
   b. Lt Col C.S.J. Duvenage: Specialist physician, female, member 1 MHREC.
   c. Lt Col L.M. Hofmeyr: Otorhinolaringologist, male, member 1 MHREC.
   d. Lt Col D. Mahapa: Dermatologist, female, member 1 MHREC.
   e. Lt Col A.D. Moselane: Urologist, male, member 1 MHREC.
   f. Lt Col E Venter: Periodontist, male, member 1 MHREC.
   g. DR T.J. Marè: Advocate, independent of the organization, male, member 1 MHREC.
   h. Mrs. C. Jackson: Layperson, independent of the organization, female, member 1 MHREC.

3. The following documents were evaluated:

   a. Study protocol "Exercise-related injury profile amongst recruits during basic military training in 3 South African Infantry Battalion at Kimberley"

4. The recommendations are: The study was approved on 28 September 2012. The principal investigator Maj. E van der Westhuizen will be supervised by Dr M Reid. Report backs are to be made to the 1MHREC six monthly, in the event of any serious adverse events and on completion or termination of the study.

M. K Baker

(M.K BAKER)
CHAIRMAN 1 MILITARY HOSPITAL RESEARCH ETHICS COMMITTEE:
LT COL / PROF

DIST

For Action

Maj. E van der Westhuizen

World Class Clinical Care
RESTRICTED

ADDENDUM D: APPROVAL: CHIEF OF DEFENCE INTELLIGENCE

RESTRICTED

DI/SDCI/DCIC/R/202/3/7

Telephone: (012) 315-0216
Fax: (012) 326-3246
Enquiries: Brig Gen E.L. Pule

Defence Intelligence
Private Bag X367
Pretoria
0001

25 May 2012

AUTHORITY TO CONDUCT RESEARCH IN THE DOD: 95741450PE MAJ E. VAN DER WESTHUIZEN

1. Your document AMHUFS/R/202/1 dd 18 April 2012 as well as the questionnaires refers.

2. Permission is hereby granted from a security perspective to Maj E. Van Der Westhuizen to conduct the research on the topic "**Exercise-related injury profile amongst recruits during basic military training in 3 South African Infantry Battalion at Kimberly**" for his/her Masters Program.

3. The final research product must first be sent DI (SDCI) for scrutiny and authority for release before it is submitted to the University of Free State.

4. For your attention.

(MAJ GEN T. MATLAKENG)
CHIEF OF DEFENCE INTELLIGENCE: LT GEN

VWM/VWM (3 SAI Maj E. Van Der Westhuizen)

DISTR

For Action

OC AMHU Free State (Attention: Maj E. Van Der Westhuizen)

Internal

DI/SDCI/DCIC/R/202/3/7

RESTRICTED

ADDENDUM E: PATIENT INFORMATION LETTER

INFORMATION LEAFLET

I, Major E. van der Westhuizen am doing research on the exercise-related injury profile of recruits during Basic Military Training in 3 SAI Bn at Kimberley.

Invitation to participate
You are hereby invited to take part in a voluntary study and are under no obligation to participate. You have the right to withdraw at any time without any negative consequences. All recruits will complete an identical questionnaire on the injuries sustained during Basic Military Training and the questionnaire will take approximately 30 minutes to complete.

What is the purpose of the study?
The research is for academic purposes and you will be asked about the injuries you sustained during Basic Military Training. The information obtained from the questionnaire will be utilized to understand the type and the possible causes of injury occurrence during Basic Military Training. Awareness of the type of injuries will aid in future planning to adjust programs with the intention of minimizing injuries.

Risks and benefits
As far as I am aware there should be no risk of discomfort to you in sharing information about injuries sustained during basic training. The study will not benefit you directly, but findings of the research will be published and you will therefore have access to the study results.

Is the information confidential?
Names will not appear on the questionnaires therefore, identities will remain a secret.

Who is the contact person?
Should you reacquire any further information regarding the study, you may contact the researcher at 051 402 2034

Unethical behaviour
The study has been approved by the Ethics Committee of the Faculty of Health Sciences at the University of the Free State as well as Defence Intelligence. You may phone the Secretariat of the Ethics Committee at 051 405 2812, if you have questions about your rights.

ADDENDUM F: INFORMED CONSENT

INFORMED CONSENT

You have already received an information sheet requesting your participation in a questionnaire on the exercise-related injury profile of recruits during Basic Military Training at 3 SAI BN Kimberley

I hereby give consent to partake in the research and I acknowledge that:

* I will be required to complete a questionnaire that will take approximately 30 minutes to complete.
* My participation is voluntary and I may withdraw at any time without any consequences.
* I will not be harmed or benefit directly from this study.
* My identity is a secret and that all information shall be treated confidentially.
* Awareness of the type of injuries will aid in future planning to adjust programs with the intention of minimizing injuries.
* Information obtained through this questionnaire will be utilized for academic purposes and will findings will be published.
* The researcher is responsible for all cost involved in the study.
* Researcher is Maj. E. vd Westhuizen and can be contacted at telephone number 051 402 2034, should I require any additional information regarding the research.
* The study has been approved by the Ethics Committee of the Faculty of Health Sciences at the University of the Free State as well as Defence Intelligence and that I may phone the Ethics Committee, if I require more information regarding my rights at telephone number: 051 405 2812.

I acknowledge that I understand the content of the consent and I wish to take part in the research questionnaire.

---------- ----------

SIGNATURE OF THE PARTICIPANT **DATE**

ADDENDUM G: QUESTIONNAIRE

By completing the questionnaire you are giving consent to participate in research on the exercise related injury profile of recruits situated in 3 SAI Bn.

This is a questionnaire that has to be completed by the respondent and coded by the researcher.

INSTRUCTIONS

Please mark the appropriate number with a X or write your answer on the space provided.

For example:

Indicate your gender

Male	X	Female	2

For Office Use [ ][ ][ ][ ] 1-4

A INTRINSIC RISK FACTORS

DEMOGRAPHIC DATA

1 Indicate your gender.

Male	1	Female	2

[ ] 5

2 Write down your date of birth. [d][d][m][m][y][y] [d][d][m][m][y][y]

3 Specify your body length in centimeters. [ ][ ][ ] cm [ ][ ][ ] 12-14

4 Write your body weight in kilogram. [ ][ ][ ] kg [ ][ ][ ] 15-17

5 Indicate your highest qualification. [ ] 18

1	Grade 12
2	Certificate
3	Diploma
4	Degree

6 Tick the box on the left to indicate your home language. [ ] 19 [ ] 20 [ ] 21

1	Sotho
2	Tswana
3	Xhosa
4	Zulu
5	English
6	Afrikaans
7	Specify other .....

7 Indicate your ethnic group.

1	Black	☐	22
2	Indian		
3	Colored		
4	White		
5	Specify other		

SOCIO-ECONOMIC DATA

8 Specify how many rooms are in your home. ☐☐ 23-24
.....rooms.

9 Write down how many people share the house with you. ☐☐ 25-27
.....people. ☐

MEDICAL HISTORY

10 On average how many cigarettes do/did you smoke per day for the past 6 months?..... ☐☐ 28-31
☐☐

10 How long have you been smoking?
Indicate years .....months..... ☐☐ 32-33

11 Are you right or left handed?

1	Right handed	☐	34
2	Left handed		

12 Do you take any chronic medication? Yes 1 No 2 ☐ 35

12 If yes, list medication ..... ☐ 36
.....

13 How often did you have a meal at home before basic training started? ☐ 37

1	less than x1 day
2	x1 daily
3	x2 daily
4	x3 daily
5	More than x3 day

14 Do you experience cramps in the lower legs during exercise? Yes 1 No 2 ☐ 38

All males please go to number: 18

FEMALES ONLY

15 Indicate your contraception use (family planning) [ ] 39 [ ] 40

1	Never used any contraception
2	Oral (tablets)
3	Injectable (2 or 3 month)
4	Specify other .....

16 How many menstrual periods did you have during basic training? [ ] 41

1	None
2	One (irregular)
3	More than one(regular)

17 Did you have a baby, miscarriage or abortion during the six month period before basic training? [ ] 42

Yes 1 No 2

B EXTRINSIC RISK FACTORS

SPORT AND FITNESS HISTORY

18 How did you rate your fitness level before you started with basic training? [ ] 43

1	Poor
2	Fair
3	Good
4	Excellent

19 Did you participate in sport or any form of exercise at least three months before basic training? [ ] 44

Yes 1 No 2

20 If yes, how many hours per week
Specify hours ..... [ ][ ] 45-47

21 If yes, in what types of sport or physical activities did you participate? (indicate one or more) 48-57

1	Soccer/ indigenous sport
2	Volleyball
3	Netball
4	Athletics
5	Running
6	Walking
7	Specify other .....

INJURY HISTORY

22 Did you suffer any form of injury during basic training?
Yes 1 No 2 ☐ 58

23 Were you prescribed any medication for an injury during basic training?
Yes 1 No 2 ☐ 59

24 If you know the name of the medication please specify.
..... ☐☐☐ 60-62

Please hand in your questionnaire if you did not sustain any injury.

THANK YOU FOR YOUR PARTICIPATION.

25 Did the injury occur while you were on duty?
Yes 1 No 2 ☐ 1

26 Did you seek medical care?
Yes 1 No 2 ☐ 2

27 If not, why not?
..... ☐ 3
.....

28 How many times during basic training did you seek medical care or assistance for injuries?
Specify .....times ☐☐ 4-6

Please complete questions 29-64 for each injury. Ask for an extra copy of the questionnaire for each injury.

29 Specify week or date (e.g. week 3 and 9)
..... ☐☐ 7/10

30 Were you given duty restrictions?
Yes 1 No 2 ☐ 11

31 Were you given light duty ?
Yes 1 No 2 ☐ 12

32 If light duty was given, specify how many days..... 13-15

33 Were you given bed rest / sick leave? Yes 1 No 2 16

34 If yes ,indicate how many days..... 17-19

35 Were you hospitalized? Yes 1 No 2 20

36 If yes, specify how many days 21-22

37 What type of injury did you sustain? (as you understand it) 23-32
(Indicate one of more)

1	Fracture
2	Stress fracture
3	Dislocation
4	Ligament
5	Muscle / tendon
6	Shin splints
7	Blisters abrasion/scratch/lacerations
8	Specify other diagnosis.....

.....

38 Were you referred to (indicate one or more) 33-40

1	Physiotherapy
2	Biokinetics
3	Orthopaedics'
4	Surgery
5	X-rays
6	None of the above
7	Specify other.....

39 Indicate affected site of injury: (indicate one or more) 41-48

1	Head
2	Face
3	Neck
4	Upper back
5	Lower back
6	Trunk (chest)
7	Abdomen
8	None of the above

40 Indicate affected site of injury as well as **right or left:**
(indicate one or more)

			R		L	R	L	
	1	Shoulder	1		1			49-50
	2	Upper arm	2		2			51-52
	3	Elbow	3		3			53-54
	4	Forearm	4		4			55-56
	5	Wrist	5		5			57-58
	6	Hand / palm	6		6			59-60
	7	Fingers	7		7			61-62
	8	None of the above	8		8			63-64

41 Indicate affected site of injury as well as **right or left**

		R		L	R	L	
1	Hip/pelvis	1		1			65-66
2	Upper leg	2		2			67-68
3	Knee	3		3			69-70
4	Lower leg	4		4			71-72
5	Ankle	5		5			73-74
6	Foot	6		6			75-76
7	Toe	7		7			77-78
8	None of the above	8		8			79-80

42 Did you experience a sharp localized pain at the affected site of injury? Yes 1 No 2 ☐ 1

43 Was the pain worse during exercise and better during rest? Yes 1 No 2 ☐ 2

44 Did the pain gradually worsen and occur even while at rest? Yes 1 No 2 ☐ 3

45 Injury symptoms were severe enough to interfere with daily activities? ☐ 4

1 All of the time
2 Most of the time
3 Some of the time
4 Never

C TRAINING PROGRAM

CONTRIBUTING FACTORS (Context)

46 How would you rate your stress level at the time of the injury? ☐ 5

1 None
2 Medium
3 High
4 Very high

47 What were you doing when the injury or pain occurred? [ ] 6-13

1	Walking
2	Drilling
3	Jumping
4	Running
5	Long distance walk
6	Hand to hand combat
7	Do not know
8	No specific activity the pain just started.

48 Indicate whether the injury occurred while or when : (indicate one or more) 14-21

1	Stumbling	[ ]
2	Falling	[ ]
3	Completing obstacle course	[ ]
4	Lifting of heavy object	[ ]
5	Tired / fatigued	[ ]
6	Dizzy	[ ]
7	Do not know	[ ]
8	Specify Other.....	[ ]

49 Indicate footwear worn when the injury occurred. [ ] 22

1	Boots
2	Running shoes
3	Do not know
4	Other
5	None

50 What were you carrying or wearing when the injury occured? (Indicate one or more) 23-27

1	Battle jacket	[ ]
2	Rifle	[ ]
3	Back pack	[ ]
4	None of the above	[ ]
5	Specify other.....	[ ]

51 How would you rate your back pack: [ ] 28

1	Adequately fitted
2	Inadequately fitted

52 What time of the day did the injury occur? [ ] 29

1	Morning
2	Afternoon
3	Evening

53 Indicate when during the exercise program the injury occurred [ ] 30

1	Start of exercise program
2	Middle of exercise program
3	End of exercise program
4	Do not know

53 Indicate when during the exercise program the injury occurred ☐ 30

1	Start of exercise program
2	Middle of exercise program
3	End of exercise program
4	Do not know

54 What were the weather conditions like? ☐ 31

1	Very hot >30
2	Normal
3	Cool
4	Very cold
5	Do not know

55 What were the weather conditions like? ☐ 32 ☐ 33

1	Strong wind
2	Raining
3	None of the above
4	Do not know

56 In your opinion did you drink enough (4-8 glasses) water on the day that the injury occurred? ☐ 34

1	Yes
2	No
3	Do not know

57 Did you have a meal (at least 1-5 hours) before the injury? ☐ 35

1	Yes
2	No
3	Do not know

58 Specify terrain when injury occurred. ☐ 36

1	Uphill
2	Downhill
3	Level
4	Do not know

59 Specify terrain when injury occurred. ☐ 37

1	Uneven
2	Even
3	Do not know

60 Indicate the surface of the terrain when the injury occurred. ☐ 39

1	Grass
2	Dirt track
3	Tar/cement
4	Rocky/gravel
5	Do not know

61 Did the injury occur when switching from one training surface to another (e.g. from grass to gravel) ☐ 39

1	Yes
2	No
3	Do not know

62 Do you think the warm-up and stretching exercises were sufficient to prevent injuries? ☐ 40

1	Yes
2	No
3	Do not know

63 Is there anything additional of concern that you want to share? ☐ 41

Yes	1	No	2

64 If yes, please specify..... ☐☐ 42-44

.....

.....

THANK YOU FOR YOUR PARTICIPATION

ABSTRAK

Die doel van die studie was om die beseringsprofiel van rekrute by 3 SAI Bn tydens BMO te bepaal. Die doelwitte was om die *demografie, sosio-ekonomiese* status en *mediese geskiedenis* van hierdie rekrute, asook die *tipe en meganisme* van oefening-verwante beserings wat hulle opgedoen het, te identifiseer en te beskryf. ‘n Kwantitatiewe, nie-eksperimentele, beskrywende ontwerp is vir die navorsing gebruik, en ‘n vraelys wat deur die respondente self voltooi is, is as data-insamelingstegniek aangewend.

Die *demografie* van die rekrute het aangedui dat die oorgrote meerderheid (83%) swart was, met slegs enkele Kleurlinge, blankes en Indiërs. Die geslagsverpreiding was 46.9% (n=173) vroulik en 53.1% manlik (n=196). Geslag (P=2.351E-10) het statisties bygedra tot beserings. Respondente het aansienlike verbeterde *sosio-ekonomiese* lewenstandaard as die gemiddelde Suid-Afrikaner gehad.

Die algehele voorkoms van *beserings* soos aangemeld was 25%, waarvan 19% deur vroulike en 6% deur manlike rekrute aangemeld is. Die beseringskoers was op sy hoogste gedurende weke 3-4 van die BMO-program. Rook, voorbehoedmiddels, amenorree en miskrame is nie statisties as betekenisvolle faktore in beseringsrisiko bevind nie. Onfiksheid is wel bewys as ‘n statisties betekenisvolle risikofaktor vir beserings (P=0.0091). Deelname aan sport (P=0.0296), en veral gewigdraende sport (P=0.0023*),* het volgens die bevindinge betekenisvol bygedra tot ‘n afname in beserings. Vroulike rekrute het hoër stresvlakke ervaar, wat statisties betekenisvol (p=0.0034) bygedra het tot die voorkoms van beserings. Die beserings wat die algemeenste voorgekom het, was knie- (40%), enkel- (19%), onderbeen- (13%) en laerugbeserings (9%). Hidrasie en voeding, asook opwarmingsaktiwiteite om beserings te voorkom, is ook ondersoek.

Die *biomeganiese aspekte* wat vermeld is, het onder andere aangedui dat die meeste van die respondente beserings opgedoen het tydens aktiwiteite wat met hardloop of val gepaardgegaan het, en die meeste het spier-/tendonbeserings en

verstuitings/ ontwrigtings gedurende opleiding op die hindernisbaan (P=0.0178) opgedoen. Die vraelysitems aangaande die rugsakke en ander vrag wat hulle moes dra, het response gelewer wat daarop dui dat dit nie ‘n impak op die voorkoms van beserings gehad het nie.

In die kategorie *Omgewingsrisikofaktore* het response rakende die weersomstandighede daarop gedui dat die respondente dit as baie warm ervaar het tydens opleiding, maar dat nóg reën, nóg wind ‘n rol by beserings gespeel het. Die *terrein* was die grootste bydraende faktor tot ligamentbeserings (P=0.0063), wat in die *namiddag* plaasgevind het, en veral in die *middel van die opleidingsprogram*.

Die *aanbevelings* behels dat taakspanne aangewys moet word om kriteria te oorweeg om rekrute se fiksheid te bepaal voordat hulle aansluit, en ook om remediërende fiksheidsopleiding te oorweeg. Ander aanbevelings hou verband met ‘n gebalanseerde fisiese fiksheidsprogram, beseringsbeheerprogramme, en gesondheidsbevorderings-programme. Aandag word ook geskenk aan die rookgewoonte, stresfaktore, die oordrag van aansteeklike siektes, hemoglobiensifting, en die gebruik van son-afweermiddels.

Sleutelwoorde: oefeningverwante beserings, rekrute, basiese militêre opleiding, muskulo-skeletale risikofaktor, fiksheid, geslag.

ABSTRACT

The aim of the study was to assess the injury profile of recruits during BMT at 3 SAI Bn Kimberley. The study objectives were to identify and describe the *demography*, *socio-economic* status and *medical history* of these recruits, as well as the *type and mechanism* of exercise-related injuries among them. The design involved a quantitative, non-experimental, descriptive design with a self-reported questionnaire as data collection technique.

The *demography* of the recruits indicated a large majority of Blacks (83%) with very few Coloureds, Whites and Indians. The gender distribution was 46.9% (n=173) female and 53.1% male (n=196). Gender (P=2.351E-10) statistically contributed to injuries. Participants had significantly better *socio-economic* living standards than the average South African.

The overall *injury prevalence* was reported as 25%, of which 19% were reported by female and 6% by male participants. Injury rates were the highest during weeks 3-4 of the BMT programme. Smoking, contraception use, amenorrhea and miscarriages prior to BMT were not found to be statistically significant injury risk factors. Being unfit was indicated as a statistically significant risk factor for injuries (P=0.0091). Having participated in sport (P=0.0296), and specifically in weight–bearing types of sport (P=0.0023*),* was found to have significantly reduced injuries. Females experienced higher stress levels which made a statistically significant (p=0.0034) contribution to injury prevalence. The most frequent *sites* of injury were the knee (40%), ankle (19%). lower leg (13%) and lower back (9%). Hydration and nutrition, as well as warm-up activities to prevent injuries were investigated.

The biomechanical aspects that were reported, *inter alia,* indicated that the majority of the respondents had sustained injuries during activities which entailed running or falling, and most sustained muscle/tendon dislocation injuries during obstacle course training (P=0.0178). The questions regarding *back-packs* and *external loads* revealed that these did not have an impact on the prevalence of injuries.

Environmental risk factor responses regarding the weather indicated that it was found very hot during training, but neither rain nor wind played a role in the injuries. The terrain mostly contributed to ligament injuries (P=0.0063) which occurred in the afternoon, especially in the middle of the training programme.

The *recommendations* are aimed at establishing task teams to consider pre-enlistment fitness criteria, as well as remedial fitness training. Other recommendations deal with a balanced physical fitness programme, injury control programmes, and health promotion programmes. Attention is also paid to smoking, stress factors, communicable disease transmission; haemoglobin screening and the use of sun block.

Keywords: exercise-related injury, recruit, basic military training, musculoskeletal risk factor, fitness, gender.