An epidemiological investigation of dance injuries in ballet dancers in the greater Durban area.

By

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I, Katleen-Jada Balding, do hereby declare that this dissertation represents my own work in both concept and execution.

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DEDICATION

I DEDICATE THIS WORK TO MY FAMILY, FOR ALL THEIR PATIENCE, SUPPORT AND UNCONDITIONAL LOVE; TO A.G, FOR HIS GUIDANCE AND LOVE; TO MISS FULLER FOR INSPIRING IN ME SUCH PASSION FOR BALLET, FOR HER STRENGTH AND UNDERSTANDING; AND TO GOD FOR HIS ABUNDANT LOVE, GRACE, PEACE AND ANSWERED PRAYER.

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ABSTRACT

Classical ballet is generally defined as a form of art although it has been found to be more physically demanding than most sports, perhaps due to its very precise technique that differs considerably from normal movement. Epidemiological studies investigating ballet injuries in other countries suggest that the incidence and prevalence of injuries among ballet dancers is high. However, no such studies had been conducted in South Africa. Consequently the purpose of this study was to determine the lifetime incidence and prevalence of ballet injuries in the greater Durban area, and to examine the association between certain individual factors and ballet injuries, in order to identify potential risk factors.

A prospective, questionnaire-based epidemiological study on ballet injuries was conducted on a sample of 100 ballet dancers in the greater Durban area. The subjects, who were between the ages of 10 and 50, and danced more than two hours per week were recruited from local dance studios and a professional company, by non-probability convenience sampling.

The lifetime incidence of ballet injuries was found to be 74% and the prevalence 30%. The majority of the sample were white (92%) females (95%), younger than 20 years of age (84%) who had started ballet before the age of 6 years (72%) and had a mean of 11.55 years of experience. Though most ballet injuries were reported as moderate in severity (46% lifetime incidence group and 60% prevalence group), the majority (98%) had in some way caused at least some limitation/pain, while 47% of the dancers in the lifetime incidence group reported having sustained an injury that prevented them dancing. The most common locations of injuries were reported to be the foot/toes, ankle, lower back and knee, and injuries were predominantly reported to be caused by insufficient rest/overwork, incorrect posture/placement, jumping, repetitive movement, insufficient warm-up/cold, twisting, pointe work and falling.

The level of care seeking among the sample population was found to be relatively high (66% lifetime incidence group and 47% prevalence group), with a significant positive association found between the severity of injury and the frequency of care seeking. The most common forms of treatment utilised by the injured dancers were physiotherapy, bracing/strapping, chiropractic and medication/injections. Cross-tabulation between the incidence and prevalence of ballet injury and various individual factors, and use of the Chi-Square and Independent T-Test Test, revealed significant associations between ballet injury and age, height, weight, years of experience, age of onset of ballet, number of hours and classes danced per week, and postural weakness.

The results of this study suggest that the lifetime incidence and prevalence of dance injuries among ballet dancers in the greater Durban area is high, and that the majority of injuries that occur affect the dancers' ability to perform at an optimum level. Potential risk factors have been identified and it is recommended that these are investigated further, in order to help develop strategies aimed at reducing the prevalence of ballet injuries.

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DEFINITION OF TERMS

Allegro, grand

Combinations of expansive jumping that incorporate advanced-level leaps (Khan et al. 1995:343).

Allegro, petit

Small jumping movements performed at a quick tempo (Khan et al. 1995:343).

Attitude

The body position when supported on one leg with the other lifted to the front, side or back, with the knee flexed (Khan et al. 1995:343).

Arabesque

The position of the body when supported on one leg whilst the other is fully extended behind the dancer (Khan et al. 1995:343).

Barre

The long bar, usually fastened to the wall of the ballet studio that dancers usually hold onto for support while warming up. The word is also used to refer to the set of exercises performed at the barre at the beginning of every class (Khan et al. 1995:343).

The Classical Ballet Positions

The technique of ballet is based on the five positions of the feet from which the steps and movements of ballet start, finish or pass through (Coplan, 2002: 579, Micheli, Gillespie and Walaszek, 1984:199). These five basic positions are characterized by turnout from the hips (Micheli, Gillespie and Walaszek, 1984:199).

Turnout angles for the five classical ballet positions are, on average, 13 to 17° more than the sum of bilateral hip external rotation (Gilbert, Gross and Klug, 1998:346).

First position – the hips are externally rotated and adducted with the heels in contact with each other. The knees are aligned over the feet (Gilbert, Gross and Klug, 1998:343).

Second position – this position is similar to first position except that the heels are a pelvis-width apart due to hip abduction (Gilbert, Gross and Klug, 1998:343).

Third position – in this position the thigh and legs contact each other. The hips are externally rotated and adducted. The knees are aligned over the feet. The heel of the front foot lies in front of the middle of the longitudinal arch of the back foot (Gilbert, Gross and Klug, 1998:343).

Fourth position – the hips are externally rotated and adducted, with the knees aligned over the feet. There is flexion at the hip joint of the forward leg and extension at the hip joint of the back leg thus allowing the feet to be apart. The front legs heel lies directly in front of the first metatarsal head of the back foot, while the heel of the back leg is directly behind the front legs fifth metatarsal (Gilbert, Gross and Klug, 1998:343).

Fifth position – this is exactly the same as fourth position excepting that the thighs and legs are in contact (Gilbert, Gross and Klug, 1998:343).

Demipointe

To balance on the plantar aspect of the toes with a fully flexed metacarpophalangeal joint (Micheli, Gillespie and Walaszek, 1984:200).

Dévelopé

The turned-out working leg is raised, generally until it is about 90º to the body and then fully extended (Khan et al. 1995:343).

En pointe

The position of the foot in the pointe shoe, in which the heel is raised, the ankle and midfoot are fully plantar flexed and the dancer stands on top of her toes, principally the first and second digits (Khan et al. 1995:343).

Jeté

To throw – in dance a jump taking off from one leg and landing on the other (Ryman,1995:45)

Plié

The movement whereby the dancer slowly bends the knees in line with the fully turned out feet (Khan et al. 1995:343).

Plié, demi

The movement to the point where the heels would have to be raised if the plie were to be continued (Khan et al. 1995:343).

Plié, grand

The thighs are parallel to the floor at the lowest point of the plie. The heels only remain on the floor in the second position (Khan et al. 1995:343).

Relévé

Rising movement of the body that starts from a demiplie, and requires a slight snatch so that it is more dynamic than a rise (Khan et al. 1995:343).

Rolling

A term used to describe the ankle when the foot is flat on the floor. The technical fault seen is excessive pronation resulting from forcing turnout (Khan et al. 1995:343).

Sickling

The term used to describe the ankle when the dancer is in the demipointe or pointe position.

Sickling in refers to when excess bodyweight is taken on the lateral portion of the foot.

Sickling out is when excess body weight is taken on the medial portion of the foot (Khan et al. 1995:343).

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Classical ballet is more than an art form, it has been found to be more physically demanding than most sports, as it requires the mastery of very specific and precise technique that differs immensely from normal movement. This technique involves turnout (external rotation) of the hips so that the longitudinal axes of the feet are rotated 180° away from one another, increasing balance, leg elevation, the range of motion at the hip joint and elegance. Pointe work involves the ballet dancer standing on the tips of her toes with the foot at 180° to the tibia (Credico and Davis, 1999:43; Gilbert, Gross and Klug, 1998:339; Haupt, 1997:168,200; Quirk, 1983:514; Milan, 1994:127).

The process of defining and classifying an injury is especially difficult for dance, as injuries must be viewed in the context of physical impairment and artistic compromise. As a result researchers have defined injuries as ballet-related injuries for which medical attention was sought; as time lost from dance or performance; or as any pain or dysfunction that impaired the dancers' ability to practice or perform (Bronner and Brownstein, 1997:87; Coplan, 2002:581; Garrick and Requa, 1993:586,588).

Ballet-related literature suggests that the incidence of ballet injuries may be as high as 90% in professional ballet dancers and 63% in student ballet dancers (Coplan, 2002:579, 583; www.alexandertechniquedance.net, 2002; Hamilton et al., 1989: 263/4; Reid, 1987:232; Sohl and Bowling, 1990:318). The prevalence of ballet injury has been found to range between 17 and 40% (Bowling, 1989:730; Coplan, 2002:579; Garrick and Requa 1993:587). Permanent disability may result from 42, 2% to 62% of ballet injuries (Bowling, 1989; Reid, 1987:233; Russell, 1994:13 and www.alexandertechniquedance.net, 2002).

Certain consistencies have been found regarding the location of ballet injuries on reviewing the literature. Lower limb injuries are the most common injuries at 65 to 80%, especially at the foot, ankle and knee, followed by the leg and hip. Of injuries involving the spine (10 to 17%), the lower back was most commonly involved, and was reported the second most commonly injured area within the dancers' body. Upper limb injuries occur far less frequently (5 to 15%), with the hand and wrist as the most commonly injured area, followed by the shoulder (Bronner and Brownstein, 1997:89; Bowling, 1989:730; Garrick and Requa, 1993:587, 589; Howse, 2000:104; Milan, 1994:121-124,126,127; Quirk, 1994:128; Reid, 1987:232; Rist and Kennedy, 1986:7; Sohl and Bowling, 1990:317,319, 320).

The most common injury in ballet is reported to be an acute sprained ankle involving the anterior talofibular ligament (Howse, 2000:104; Malone and Hardaker, 1990:356).

Two main categories of dance injuries have been identified: overuse injuries (that have a variety of causes such as poor technique, repetition, structural variation, postural defects, muscular imbalance and equipment) and traumatic injuries, which are more rare (Rist and Kennedy, 1986:1). Overuse causes of injuries have been identified such as: twisting, fatigue, partnerships, bad teaching, difficult choreography, stretching, jumping, pointe work, environmental such as inadequate facilities, temperature and the floor (Bronner and Brownstein, 1997:93; Hamilton, 1998:163; Howse, 2000:74; Milan, 1994:127; Rickett-Young, 1996:3; Sohl and Bowling, 1990: 318; Weisler et al, 1996:754).

Literature suggests that the majority of ballet dancers seek treatment after injury, from physiotherapists, medical practitioners, masseuses, acupuncturists and osteopaths. Prior to being injured it has been found that less than half of ballet dancers practice preventative exercises as compared to the majority after injury. It has also been found that very few ballet dancers stop dancing and rest immediately after injury, perhaps due to a fear of a loss of flexibility and time lost from practice (Credico and Davis, 1999:46; Fernandez-Palazzi, 1990:259; Sohl and Bowling, 1990: 318).

Diet and body weight are major concerns of ballet dancers. For approximately 150 years the ballet dancer has been required to be slim. This thinking begins early in the ballet dancers training and continues throughout the dancers' professional career often resulting in the development of eating disorders such as anorexia nervosa. Unfortunately ballet dancers do not expend as many calories in energy as they consume and this often results in them eating less than adequate amounts, leading to nutritional deficits. These nutritional deficits may result in menstrual disturbances that in turn can contribute to musculoskeletal injuries such as stress fractures and osteoporosis (Benson et al., 1989:58, 59; Hamilton et al., 1989:265, 266; Hamilton and Hamilton, 1992:269; Hamilton, 1998:155; Hunter, 1994:27; Reid, 1988:305).

A dancers' age, and the level and length of training play a role in injury development and treatment. Females begin ballet training at an early age, often as young as 4 years of age. They then train for approximately 11 years before turning professional. In contrast men start training later nearer 15 years of age, turning professional after 7 years of training (Hamilton et al. 1989:264, 266; Micheli, 1983:473; Reid, 1988:296). Younger dancers are more likely to develop injuries at the knee or hip while older dancers are more affected at the lower leg. Professional ballet dancers do not allow adequate rest periods to recover from injury; despite the fact that older dancers are more often injured and require a longer recovery period (Bronner and Brownstein, 1997:88; Gelabert, 1986:187; Hamilton et al. 1989; Micheli, 1983:473).

The role of male dancers in ballet is completely different to females, which explains the differences in injury patterns found between genders. Female ballet dancers are required to be exceptionally flexible, have 180° turnout and dance en pointe. Female dancers constantly strive to perfect their technique, often to that which is greater than their body allows. Perfect ballet technique is not an absolute requirement for men, it is considered more important to be able to jump and lift (Hamilton and Hamilton, 1992:271).

Ballet dancers are very goal orientated and dedicated people, which may contribute the development of injury. Male ballet dancers appear more stressed than female ballet dancers (Hamilton et al. 1989:266).

Structural variations within the dancers' body may also predispose to injury due to the inability of the lower limb to absorb impact. Other variations may cause difficulty in the performance of movements that are essential to ballet technique (Hamilton, 1986:66; Malone and Hardaker, 1990:360).

Ballet technique was developed on the physique of Europeans. Other ethnic groups who perform this technique are more susceptible to injury due to the differences present in their physiques, resulting in a higher injury incidence (Gelabert, 1986:187).

Ballet class is a structured method of preparation for performance in which the essentials never vary as the foundation for training (Buckroyd, 2000:69; Malone and Hardaker, 1990:355; Sparger, 1949:11). The class follows a specific order, starting with a warm-up that is slow, to increase body temperature and stretch the involved muscles, ligaments and tendons (Rickett-Young, 1996:29; Rist and Kennedy, 1986:83). Barre work follows warm-up for approximately 45 minutes where exercises are performed with the support of the barre to perfect stance, stability and turnout while emphasizing bending and stretching of the leg, and hip adduction and external rotation. Static stretching follows for about 10 minutes.

After the barre exercises are repeated in the centre, unsupported to achieve balance, strength, control and line. Pirouettes or turns on one leg are practiced as well as adage, which incorporates slow controlled movements with the head, arm and body. Allegro follows and incorporates all jumps (small, beaten and large). Pointe work is the culmination of class, and the end result of training where pointe technique is practiced to develop the strength and balance to dance on the tips of the toes (Khan et al., 1995:342; Malone and Hardaker, 1990:355; Reid et al., 1987:349)

Despite epidemiological research from other countries suggesting that the incidence and prevalence of injuries among ballet dancers is high no such studies have been conducted in South Africa. It was thought that demographics in terms of male: female ratios, ethnic composition and environmental conditions might differ as compared to studies conducted in other countries. A South African study (in this case limited to the greater Durban area) was therefore necessary to establish whether or not the general trend in South Africa followed the global trend. Specifically, epidemiological research is required in South Africa, as it would help quantify the extent of the problem, help identify potential risk factors thus aiding the prevention of injuries, and the training, treatment and management of dancers (Rist and Kennedy, 1986:7; Sohl and Bowling, 1990:321). Should the trend in South Africa not follow the global trend then further research into possible factors identified in this research will be recommended.

1.2 OBJECTIVES OF THE STUDY

1.2.1 The first objective was data collection and documentation with respect to:

- Patient demographics
- Anatomical location
- Mechanism of injury
- Diagnosis of the injury
- Type of treatment / management
- Prevalence
- Incidence

1.2.2 The second objective was to interpret the data using cross tabulations and the Chi-Square Test to assess the strength of the relationship of the various factors documented in objective one.

CHAPTER 2

A REVIEW OF THE RELATED LITERATURE

2.1 INTRODUCTION

Dance can be defined as the conscious effort to create visual designs in space by continuously moving the body through a series of poses and pattern tracings (http://www.clevelandclinic.org/health, 2000).

Ballet dancing is further characterized by turnout of the hips, rising up on the toes, elevation, beats, turns and toe dancing (http://www.clevelandclinic.org/health, 2000). In ballet, the body is the dancer's instrument of expression and unlike most instruments is carried wherever the dancer goes. Like sport, ballet demands fitness, stamina, agility and strength; but also demands grace, beauty, ease, musicality and line (http://e-dancewear.com, 2002), as the movements of ballet are synchronized to a particular rhythm (http://www.clevelandclinic.org/health, 2000).

As the standard of ballet increases over time, increasing physical demands are placed on dancers, who are pushed further toward their physical limits. It is in seeking to perform a perfect art with an imperfect physique that most injuries occur (Rist and Kennedy, 1986: xv). Professional ballet dancers may create beautiful movements, but compared to 61 common sports, only professional football is more physically demanding (Hamilton and Hamilton, 1992:267; http://www.clevelandclinic.org/health, 2000).

The quality and quantity of research into ballet injuries is poor, despite the suggestion from the little research that has been conducted, that the incidence and prevalence of ballet injuries is high.

2.2 DEFINITION OF BALLET INJURIES

The process of defining and classifying an injury is especially difficult for dance as compared to sport injuries, as dance injuries must be viewed in the context of physical impairment and artistic compromise (Garrick and Requa, 1993:586).

Dancers are required to be musical, have a compelling stage presence and take continual risks in front of a live audience (Hamilton et al., 1989:263). It is not enough to just perform movements; they must be performed in an aesthetically pleasing manner, and for this reason researchers have failed to arrive at a satisfactory definition of dance injuries (Garrick and Requa, 1993:586).

A sensitive way to define dance injury would be to label it “a dance related injury for which medical attention was sought” (Garrick and Requa, 1993:588). This definition however becomes problematic, as dance is a highly competitive sport where there is often a large and talented labour pool waiting in the wings for the opportunity to perform. This may bring about an element of paranoia amongst ballet dancers (Garrick and Requa, 1993:588) as they push themselves to dance while injured, leading to the development of further injuries. The aspiring dancer often believes that the perfection of his or her art form takes precedence over his or her condition (Weisler et al., 1996:754), resulting in ballet dancers dancing while injured, thus increasing the severity of their injury and predisposing them to further injuries (http://e-dancewear.com, 2002).

Another way of defining dance injury would be to define it as time lost from dance or performance, as was used in Bronner and Brownstein’s (1997:87) study where they profiled dance injuries in a Broadway show. Athletic injury is often based on time lost from play (Bronner and Brownstein, 1997:87). This again has its own set of problems with the involvement of subjectivity, the willingness of one athlete to perform with an injury that another finds too impairing (Bronner and Brownstein, 1997:87).

Coplans' questionnaire-based study (2002:581) on self-reported injury defined injury as "any pain or dysfunction that impacted the dancer's ability to practice or perform". Similarly, Bronner and Brownstein (1997:87) found that dancers who self-report an injury might include any problem which prevented their optimal aesthetic performance, yet still allowed them to perform.

In this study no specific conditions were applied to the definition of ballet injuries. "Injury" referred to any event or symptom experienced by the ballet dancer, at any stage in their dance 'career', which they considered to be a ballet-related injury.

2.3 INCIDENCE

Incidence is defined as "the rate at which healthy people develop a new symptom or disease over a specific period of time" (Borenstein et al., 1995:22).

A review of the related literature suggests that up to 90% of professional ballet dancers and 63% of student ballet dancers suffer ballet-related injuries at some point in their career (Coplan, 2002:579; www.alexandertechniquedance.net, 2002). Statistics show that 100% of retired ballet dancers reported at least 1 injury in their career (Coplan, 2002:579). In Bowlings' questionnaire-based study on professional ballet and modern dancers in the UK, 84% of dancers had experienced an injury that had affected their dancing at some time (Sohl and Bowling, 1990:318).

In this respect Hamilton et al. (1989:263/4) performed a survey on 29 professional ballet dancers from the New York City Ballet and American Ballet Theatre where the incidence of ballet injury was found to be 50 to 80%. According to Russell (1994:12), statistics show that the average professional dancer has a career of 12 years and a 90% chance of being injured.

In a study of 75 ballet students between 10 and 18 years of age, 58% had suffered one or more ballet injuries (Reid, 1987:232). In Coplans' study (2002:583) of 30 ballet dancers, 47% reported a history of injury. The discrepancy between the prevalence of injury in students and professional ballet dancers may be because ballet students have had less exposure to dance and a lesser chance of injury as compared to professional ballet dancers (Coplan, 2002:583).

For the purpose of this study, "incidence" reflected any injuries sustained during the subject's ballet 'career'.

2.4 PREVALENCE

Prevalence is defined as "a measure of the number of people in a given population that have a symptom or disease at a particular time" (Borenstein et al., 1995:22).

In this study "prevalence" reflected the number of subjects who reported suffering from a ballet–related injury at the time the questionnaire was completed.

Most research into the prevalence of dance injuries is poorly quantified due to failure to report sample size, sample frames and the response rate of the research (Sohl and Bowling, 1990:317). Underreporting of injuries also leads to a "lower than actual" number of injured cases. This decreases awareness and increases bias in many related studies (http://ya-ti.tripod.com, 2001).

Svensson and Andersson (1982:47, 50) found that lifetime incidence rates based on interviews tend to be an underestimation. Svensson et al. (1990:374) similarly state that, due to the problem of recall, data on lifetime incidence must be considered to be lower than the actual values, but state that prevalence data is quite accurate. Bowling (1989:731) also found there to be problems with recall when asking respondents to document events that occurred some time previously. Few problems were observed when questions were limited to recent time periods. This suggests that prevalence rates established from questionnaire-based studies should be quite accurate.

Bowling (1989:731) performed a postal questionnaire based study of 188 professional ballet and modern dancers in the UK. Of the 75% of dancers who responded 42% had sustained at least one injury in the previous six months that had affected their dancing. Similarly, Garrick and Requa (1993:587) investigated the epidemiology and financial outcome of ballet injuries during three seasons (years) for a large professional ballet company. Their results showed that 104 of the 282 dancers sustained 309 injuries during the three-year period. This worked out to be 2,97 injuries per injured dancer where each dancer had a range of one to twelve injuries. Twenty-three percent of the injured dancers sustained five or more injuries each.

A report from the New York City Ballet stated that on any one day, 17% of the ballet dancers were unable to dance due to injury (Coplan, 2002:579).

2.5 DISABILITY

A review of the literature suggests that dance related injuries may lead to permanent disability. This is shown in Bowlings' study (1989:732) where half of the respondents reported at least one chronic injury that gave them continuing problems. Reid (1987:233) found that 42,2% of the dancers involved in his study who had suffered injury had recurring problems in the same area. Another study performed at Ballet West suggested that 62% of dancers suffered temporary or permanent disability as a result of injury (www.alexandertechniquedance.net, 2002). Similarly, Russell (1994:12) reported that statistics show that the average professional dancer has a 60% chance of being disabled by injury. Garrick and Requa (1993: 587) found that of the 104 injured ballet dancers involved in their survey, six suffered from injuries that resulted not only in the cessation of their ballet career, but also substantial lifelong disability.

2.6 LOCATION OF INJURIES

2.6.1 The most common location of injuries

Upon reviewing the literature, Milan (1994:121) found there were certain consistent findings:

- Lower limb injuries account for 65- 80% of all injuries in ballet,
- Spinal injuries for 10-17% and
- Upper limb injuries for 5-15%

Bowlings' study (1989:732) found that injuries in the back and neck, and ankle were the most commonly reported sites of recent (26% and 19% respectively) and chronic (29% and 20% respectively) injury; followed by the knee, thigh/leg, other body (e.g. hip), foot and toes. Sohl and Bowling (1990:318) published Shaw's results (1977) of a focused study of dance students at the University of Utah, USA from an unpublished MA thesis. Shaw (1977) found that the most common sites for injuries to occur in dance students were the knee (17,7%), ankle (13,7%), leg (11,3%), back (9,9%), foot (8,9%), pelvic girdle (5,9%) and the achilles tendon (4%).

In an analysis of ballet injuries performed by Quirk (1983:507/8) on 2113 consecutive ballet injuries sustained by 664 dancers (71% female, 29% male) from the Australian Ballet and the Australian Ballet School, involving ballet dancers from the age of 5 years to leading professionals, it was shown that dance injuries are mainly soft tissue injuries – 28,9% in muscle, 17,1% in tendons and 15% in ligaments. These three tissues accounted for 61% of all injuries. This was similar to the results of Bowling's (1989:732) study that found chronic muscular injuries were most common (48%), followed by fractures and dislocations at 22%. Of the recent injuries, tissue injuries again were the most common at 60% (this included strains and sprains). Twelve percent reported bad bruising, swelling or inflammation of muscles, a further 12% reported fractures and 16% reported dislocated joints, cartilage and vertebral injuries (Sohl and Bowling, 1990:318).

Quirk (1983:512/13) found that stress fractures occurred in student dancers as a result of an increase in training, and in professional dancers after a heavy workload on an unsuitable floor. Stress fractures most commonly affect the foot, ankle, shin, knee, hip and spine (Hamilton, 1988:165).

Overuse syndromes are more common than acute injuries in ballet dancers, and are the result of repetitive overloads (Hamilton, 1988:158). These syndromes include achilles tendonitis, patella tendonitis, patellofemoral pain syndrome, snapping hip, bursitis, hamstring and groin strains and chronic lumbar hyperextension syndromes (Hunter, 1994:27). Despite this, Howse (2000:104) and Malone and Hardaker (1990:356) reported that the most common injury in dancers was an acute ankle sprain involving the anterior talofibular ligament of the ankle. If severe enough, the calcaneofibular ligament may also be injured. Other acute injuries include knee sprains, low back injuries and neck injuries (Hunter, 1994:27).

Garrick and Requa (1993:587, 589) found the foot to be the most frequently injured area of the dancers body at 23,9%, followed by the lumbar spine (23,09%). Locations distal to the pelvis accounted for 57,1% of injuries. After the foot, the ankle was the next frequent with 13,3%, the knee with 6,8%, the leg 6,1% and the hip with 5,8%. It was reported that ballet injuries involving the lower extremities were the major type of injuries in multiply injured dancers. The hand was the most frequently injured area in the upper extremity at 4,9%. The upper extremity accounted for 9,1% of injuries. Of the nine major injuries that were reported, 5 injuries were to the knee and one each to the lumbar spine, hip and foot. One injury was ascribed to anorexia nervosa.

Knee injuries were the most common injury in Reid's study (1987:232) at 20,1%, followed by ankle injuries (15,4%), the foot (13,1%) and the leg (8,4%). The lower limb constituted 73,7% of the injuries, 11,9% involved the trunk, 9,6% were to the upper limb and 4,8% to the head and neck.

2.6.2 Upper limb injuries.

According to Milan (1994:127) upper limb injuries are uncommon and comprise 10% of all injuries in ballet. They mainly affect the wrist and hand (5%), the shoulder (2,4%), and the elbow and upper arm both at 1,2%.

Shoulder injuries appear to be caused mainly by frequent or unaccustomed lifting and poor catching techniques used by male dancers while partnering. Typical injuries include acute traumatic bursitis, primary acromioclavicular pathology, cervical disc pathology, thoracic outlet syndromes, brachial plexus injuries and whiplash and are normally treated by rest and oral anti-inflammatory medication (Sohl and Bowling, 1990:319). Rotator cuff strains are also fairly common, and tend to occur because of a fall onto an outstretched hand or from lifting a ballerina (Milan, 1994:127).

Lateral epicondylitis is common in the elbow from repetitive handstands and raising the body into a press up position (Milan, 1994:127).

Acute wrist injuries occur in attempting to stop a fall, while overuse injuries can develop at the radial and ulnar borders of the wrist (Milan, 1994:127).

2.6.3 Spinal injuries.

Spinal injuries are reported to occur in 10-17% of ballet dancers. The lumbosacral region comprises 69% of these injuries, the thoracic spine 21% and the cervical spine 10% (Milan, 1994:126). The lumbo-pelvic region accounted for

34% of injuries in Bronner and Brownstein's study (1997:89) as the second most frequently injured area, after the ankle-foot region. Although back injuries occur less frequently than other injuries, they tend to be severe and may prevent a dancer from participating in rehearsal for as long as a season (Micheli, 1983:473).

Spinal injuries such as sprains, prolapsed or herniated intervertebral discs and spondylolytic stress fractures occur at any age or level of skill (Micheli, Gillespie and Walaszek, 1984:206; Sohl and Bowling, 1990:317). Mechanical lower back pain is the most common back disorder among young dancers (Micheli, 1983:479). Lower back pain is also common among more mature dancers as a result of demanding technique and prolonged hours of training and rehearsals (Gelabert, 1986:180).

The incidence of back injury is higher in male dancers as a result of a lack of flexibility and from performing complicated lifts. Female dancers are less at risk since they have more flexible spines and do not lift heavy weights (Gelabert, 1986:180). Despite this, spondylolysis of the spine is three times more common in adolescent female dancers than the general population. It is more frequent in females because they begin training earlier than men, before the union of the pars interarticularis (Micheli, 1983:480; Milan, 1994:126). The pars interarticularis is especially vulnerable to trauma in positions that are common in ballet such as the hyperlordotic and hyperextended position, where the back is held too straight and the hip is lifted while trying to extend the leg too high. This position is also implicated in intervertebral disc and zygopophyseal joint trauma (Milan, 1994:126). These injuries may eventually lead to arthritic change and spinal stenosis (Gelabert, 1986:183). Females tend to experience lower back pain due to the many hours they spend holding their backs in poses, such as high arabesques and attitudes, which require maximum effort of the lower back (Gelabert, 1986:180).

Overuse back injuries are more common than traumatic injuries, such as from a single twist or fall (Micheli, 1983:473). Several risk factors have been identified for spinal overuse injuries: –

1. Training errors, including abrupt changes in intensity, duration, frequency of training and style of dance resulting in disc, ligament and tendon injury (Micheli, 1983:473; Sohl and Bowling, 1990:317).

2. Musculotendinous imbalance affecting strength and flexibility (dance technique) – it is essential to maintain the lordosis of the lumbosacral junction, not allowing hyperlordosis or pelvic flexion to occur. Particularly problematic is the dynamic hyperlordosis that occurs in movement, such as jumping, lifting or turning, or during attitudes and arabesques. Hyperlordosis occurs in young dancers due to a muscle imbalance between weak abdominal muscles and tight thoracolumbar fascia, which, when combined with poor turnout, increases the risk of back injury (Khan et al., 1995:354; Micheli, 1983:474, 477)

3. Anatomic malalignment of the lower extremity, this includes leg length inequality, abnormality or rotation of the hips, patella position, bowlegs, knock knees or flat feet (Micheli, 1983:474).

4. Shoe wear, due to their improper fit and inadequate impact absorbing material, ballet shoes may contribute to back injury (Micheli, 1983:474).

5. Floor surface, such as a hard stage may contribute to back injury (Khan et al., 1995:354; Micheli, 1983:474).

6. Concomitant lumbar spine and hip extension is necessary to achieve the aesthetic extension movements in ballet such as the arabesque. Currently dancers aim for extension of the leg, above 90°. If there is decreased hip

extension, excessive torsional stress is placed on the lumbar spine and the dancer compensates by hyperextending the lumbar spine. The repetition of the incorrect hyperextension of the lumbar spine results in injury especially when the back is held too straight instead of increasing pelvic inclination while extending the hip (Gelabert, 1986:182; Milan, 1994:126; Quirk, 1983:509).

7. Growth, especially a growth spurt, has been identified as a risk factor for back injury due to the decrease in flexibility as a result of accelerated bone growth and tightening of muscles and tendons in the thoracolumbar region, and the anterior hip, leading to an increased lumbar lordosis and kyphosis of the thoracic spine (Micheli, 1983:477).

Ballet posture requires the dancer to flatten the lumbar lordosis, working towards a "flat back". To achieve this the pelvis is tilted posteriorly, predisposing the anterior hip capsule and ligaments, the hip flexor muscles (iliopsoas, rectus femoris and sartorius) and the sacroiliac joints to injury, especially in movements like the arabesque. This posture decreases shock attenuation and may contribute to lumbar disc injury (Khan et al., 1995:346, 354).

Another spinal injury that can occur in ballet dancers is the psoas insufficiency syndrome. This, according to Milan (1994:126), occurs when there is weakness and tightness of the psoas muscle resulting in the dancer standing with the hips slightly flexed and with an increased lumbar lordosis, displacing the centre of gravity anteriorly. This syndrome is also associated with weak, stretched abdominal muscles. The external rotation of the hip needed for turnout is limited by psoas tightness. This syndrome predisposes injuries along the kinematic chain as compensations to achieve the appearance of turnout occur in the knee, ankle and foot.

Lumbar, thoracic and cervical injuries can be caused in the male dancer when lifting a female partner. This can occur where there is an excessive lumbar lordosis or the female dancer is lifted too far away from the male dancers' centre of gravity (Milan, 1994:126; Quirk, 1983: 508). Overuse thoracic and cervical injuries may occur as a result of joint stiffness, muscle imbalance and referred pain (Khan et al., 1995:355).

2.6.4 Hip injuries.

Reid (1988:296) stated that the prevalence of hip injury in ballet is 7 to 14%. Snapping hip is common but rarely problematic (Sohl and Bowling, 1990:320). According to Milan (1994:121) painful snapping hip was the most frequent complaint of ballet dancers (44%). Bursitis (23%), especially at the greater trochanter, may also occur, along with stress fractures (7%), with the majority at the femoral neck (6%) (Milan, 1994:121; Sohl and Bowling, 1990:320). Degenerative change and osteoarthritis (7%) can occur after persistent attempts to improve external rotation of the hip after the age of 11 as at this age the femoral neck can no longer be altered which leads to calcification of the capsule at the acetabulum (Sohl and Bowling, 1990:320).

Muscle strains (8%) and miscellaneous conditions such as osteitis pubis (3%) and synovitis (3%) are less common problems (Milan, 1994:121). Sciatic nerve damage may occur because dancers are so slim there is a risk of injury while performing floor exercises (Sohl and Bowling, 1990:320).

Milan (1994:122) reported on the belief that muscle imbalance and altered soft tissue flexibility occur at the hip joint in ballet dancers, because ballet movement emphasizes hip flexion, external rotation and abduction. Internal rotation and adduction are thus seldom required, resulting in adaptive shortening of the lateral hip joint capsule and the external rotators then limiting internal rotation. The gluteus medius and iliotibial band are then also affected and shortened which results in limited hip adduction (Milan, 1994:122). Thus, abnormalities in soft tissue adaptations may result in injuries such as the painful snapping hip, trochanteric bursitis, iliotibial band syndrome and other lower extremity problems (Milan, 1994:122).

2.6.5 Knee injuries.

According to Milan (1994:122) knee injuries account for 14 to 20% of all ballet injuries. The knee and calf regions were injured in 8% of the cases in Bronner and Brownstein's (1997:89) study. Peripatellar pain is reported to be the most common knee condition at 50% of knee problems (Milan, 1994:122; Reid, 1988:301), and occurs more commonly among young and inexperienced dancers (Micheli, Gillespie and Walaszek, 1984:205). Another study, by Washington (1978), reported on by Milan (1994:123), found that ligamentous injuries were the most common knee injury at 44% and patellofemoral problems were less frequent at 20%. Self-reporting was required in Washington's (1978) study, which required the dancers to have an accurate memory of their injury and a clear interpretation of the diagnosis, which may account for the lower prevalence of patellofemoral problems in this study.

Less than 20% of peripatellar pain is the result of chondromalacia patella. Other conditions diagnosed under peripatellar pain include synovial plica syndrome, laterally subluxing patella, lateral pressure syndrome, Hoffa's fat pad syndrome, bursitis and patella stress fractures (Milan, 1994:122, Reid, 1988:301). These conditions can be caused by patellofemoral malalignment, especially if most of the turnout is achieved at the knee due to inadequate hip turnout (Hamilton, 1986:62). Patella malalignment contributes to knee injury when forcing turnout, which leads to lateral tracking of the patella as a result of vastus lateralis overutilisation (Khan et al., 1995:353).

Contributing factors in knee injuries include repetitive jumping (sautés), deep knee bends (pliés), substandard footwear, poorly resilient dance surfaces, muscle imbalances, inadequate strength, long hours of practice and incorrect turnout (Milan, 1994:122; Reid, 1988:302). To increase turnout and enable them to stand in the fifth classical dance position dancers often resort to “screwing of the knees” (Milan, 1994:122). This involves standing in the demiplié position and externally rotating the feet in line with the coronal plane. When this is achieved the dancer extends the knees to maintain external rotation, thus placing considerable stress on the medial aspect of the knee joint and increasing the risk of patellofemoral joint problems, medial collateral ligament sprain and/or medial meniscus tearing (Coplan, 2002:580; Khan et al., 1995:353; Milan, 1994:122). This position does not only affect the knees, but also results in midtarsal joint abduction and subtalar pronation (Marshall, 1988:179).

Hyperextension of the knees, although aesthetically desirable as it produces a more pleasing line of the leg en pointe, is another mechanism of knee injury that leads to muscle strains, and capsule and ligament sprains in the knee posteriorly. Patellar tendinitis can be associated with Osgood-Schlatters disease in the ballet dancer and can be precipitated by the many hours of ballet in which the dancer participates (Milan, 1994:123; Reid, 1988:302).

2.6.6 Lower leg injuries

Lower leg injuries constitute 5 to 8% of ballet injuries (Milan, 1994:124). According to Milan (1994:124), the most common condition affecting the lower leg is shin splints.

In shin splint syndromes the pain may originate from a tibial stress fracture, chronic periosteal avulsion, muscle tissue microtears, interosseous membrane irritation or from an increase in the lower leg compartmental pressure (Milan, 1994:124).

Clinically it can be useful to divide the symptoms of shin pain according to their location. According to Khan et al., (1995:351) anterior shin pain occurs more often due to periostitis or fasciitis. The anterior tibialis continuously overworks to maintain balance and compensate when the dancer dances with the body weight too far back. Dancers may complain of anterior shin pain on leaping. Overworking the tibialis posterior and soleus muscles may result in medial shin pain. Stress fractures, periostitis and chronic compartment syndromes may occur after excessive loading on the medial aspect of the tibia while forcing turnout. Lateral shin pain is seen most commonly in dancers with poor turnout and tibial bowing as they evert the foot in order to achieve a straight lower leg. Lateral shin pain may also be the result of a fibular stress fracture (Khan et al., 1995:352).

The aetiology of shin splints is multifactorial. Causes include a hard, nonshock-absorbing floor; thin-soled, unsupportive shoes; insufficient warm up and incorrect turn out. Incorrect turnout; with compensatory external rotation of the knee, ankle and foot; leads to “rolling in” of the foot or pronation. This places additional strain on the muscles controlling pronation, precipitating the shin splint syndrome (Milan, 1994:124).

Another cause of lower leg pain may be calf strain, which occurs when the gastrocnemius and soleus muscles are overworked in ballet dancers who dance with their body weight back rather than centred over their feet (Khan et al., 1995:352).

2.6.7 Foot and ankle injuries.

Ankles and feet are subject to an enormous amount of stress, often having to deal with 5 to 8 times the body’s weight, which is transmitted through the feet and legs when landing from jumping (Rist and Kennedy, 1986:7). The ankle is constantly stressed at the extremes of the joint range, in pointe work, plié and the jeté (Reid, 1987:234). Bronner and Brownstein (1997:89) found the combined ankle-foot region to be the most commonly injured area (50%) during their study.

Ankle and foot injuries accounted for 76% of missed performances and 74% of partial performances in their study.

Milan (1994:124) found that ankle injuries constituted 15 to 22% of ballet injuries while foot injuries made up 13 to 15%. Sixty five percent of foot pain arose from the great toe and 26% from the longitudinal arch (Milan, 1994:125). Foot and ankle injuries are reported to be more common in experienced or professional dancers (Micheli, Gillespie and Walaszek, 1984:205).

Foot and ankle injuries can be acute or chronic but it has been found that chronic injuries are more common due to the repetitive load on the ballet dancers' feet while dancing on an unyielding floor (Malone and Hardaker, 1990:356).

<u>Common foot and ankle injuries in dance are:</u>

- Ankle sprain - the acute inversion ankle sprain is the most common traumatic injury in ballet (Hamilton, 1986:62; Quirk, 1994:128) and the most commonly reported ankle injury (Milan, 1994:124). The anterior lateral ligament or anterior talofibular ligament is damaged in this injury due to forced inversion of the plantar flexed foot. This often happens on poor landings, missteps or while working on demipointe. It may also occur because of poor-quality floors and general muscle fatigue, or it can occur after a slight loss in balance or a lapse in concentration (Malone and Hardaker, 1990:356; Milan, 1994:124; Quirk, 1994:128). The sprain of this ligament may lead to permanent instability (Sohl and Bowling, 1990:317).

  Eighty degrees to 100° dorsiflexion of the toes is required to achieve a correct demipointe. If there is less dorsiflexion available, the dancer rocks onto the lateral ray of the foot, "sickling" to compensate (Khan <u>et al.</u>, 1995:346; Marshall, 1988: 183; Milan, 1994:125). This predisposes the dancer to ankle inversion sprains and malalignment syndromes of the lower limb (Marshall, 1988:183; Milan, 1994:125).

- Achilles and Flexor Hallicus Longus Tendinitis - frequent and excessive stress is placed on both of the achilles and flexor hallicus longus tendons when the dancer is in the position of demipointe (weight bearing on the metatarsal heads), en pointe (entire foot 180° to tibia) and plié (dorsally flexed ankle). The achilles tendon is stressed en pointe or demipointe due to the forceful contraction of the gastrocnemius and soleus muscles. In these positions flexor hallicus longus acts as a primary stabilizer of the medial foot, first ray and ankle. The achilles tendon is forcefully stretched during the plié while flexor hallicus provides plantar-flexor stability of the hallux. These stresses may contribute to the development of tendinitis in these tendons (Milan, 1994:124).

  Other contributing factors leading to the development of achilles tendinitis are a tight achilles tendon, congenitally thin or small achilles tendons, repetitive jumping, poor shock absorptive quality of the floor, "rolling in" of the feet, a cavus foot, inappropriate foot wear, valgus heel, poor gastrocnemius-soleus flexibility, an improper exercise routine and prolonged pointe work (Fernandez-Palazzi et al., 1990:257; Malone and Hardaker, 1990:360; Hamilton, 1988:156; Milan, 1994:124). Achilles tendinitis is also common after tying ankle ribbons tightly so that the achilles tendon is compressed (Malone and Hardaker, 1990: 360; Quirk, 1983: 508; Quirk, 1994:125/6). Factors contributing to the development of flexor hallicus longus tendinitis are the repetitive nature and stress of ballet, especially when overused during turnout and rising up en pointe (Quirk, 1994:125/6).

  Acute rupture of the achilles tendon occurs more often in male dancers over 30 years of age and may be preceded by tendinitis or degeneration (Hamilton, 1986:62; Hamilton, 1988:157).

- Posterior impingement syndrome of the ankle – Stieda's process (an enlarged lateral process on the posterior surface of the talus that is present in 38% of the adult population) or an os trigonum (an accessory ossicle posterior to the talus that is present in at least 5% of feet) may compress soft tissues when dancers' stand on pointe or demipointe, with the ankle in full plantar flexion (Quirk, 1983: 512; Quirk, 1994:126; Reid, 1992:260; Yochum and Rowe, 1996:293). Posterior impingement, a common source of pain in ballet dancers, occurs during extreme plantarflexion when the posterior capsular tissues are compressed by Stieda's process or the os trigonum between the posterior margin of the tibia and the superior portion of the calcaneus.

  Posterior impingement syndrome may also occur after an ankle inversion sprain when the lateral ligaments are lax and may allow for excessive anterior talor translation causing the posterior margin of the tibia to rest on the calcaneus (Milan, 1994:125).

- Anterior ankle impingement may occur during extreme dorsiflexion where the anterior lip of the tibia contacts the talar neck. Contributing factors for the development of this condition are excessive extensibility of the achilles tendon and the posterior capsule, a cavus foot and laxity of the lateral ankle ligaments (Milan, 1994:125). In this condition the patient complains of a lack of depth of plié (Malone and Hardaker, 1990:359). Male dancers who are cast for roles that incorporate grand allegro are more prone to the development of anterior ankle impingement syndrome (Khan et al., 1995:349).

- Calcaneal bursitis – the bursa that lies between the achilles tendon and the posterior aspect of the calcaneus may become inflamed, painful and distended after overuse, especially when there is an increase in training with upcoming examinations, auditions and performances (Quirk, 1994:128; Reid, 1992:192).

- Anterior ankle osteophytes – traction osteophytes are not uncommon on the lower tibia from the dancers frequently pointing their feet (Quirk, 1994:129).

- Medial longitudinal arch pain – pain in the medial longitudinal arch may be directly related to soft tissue stress on "rolling" of the foot (Milan, 1994:125).

- Cuboid subluxation is reported to cause 17% of all foot and ankle injuries in ballet dancers and its incidence appears to be higher among professional dancers than athletes. It is a condition that is more common in female dancers when rising from flat foot to demipointe to en pointe and the reverse. The repetitive dorsiflexion and plantarflexion movement gradually decreases the stability of the tarso-metatarsal and midtarsal joints, and the tendency of the forefoot to be in the valgus position when on relévé predisposes the dancer to cuboid subluxations as an overuse syndrome. Male dancers may develop this acutely if they land from a jump on a pronated foot. Cuboid subluxation may also develop after a traumatic sprain of the lateral foot (Marshall and Hamilton, 1992:169-171).

- Acute fractures – the most common acute fractures to occur in dancers are fractures involving the distal third of the fifth metatarsal, known as the "dancers fracture". This fracture occurs after losing balance while dancing on demipointe when the dancer rolls to the lateral border of the foot (Hamilton, 1988:151).

- Stress fractures – these are found in dance students after increasing their dance classes disproportionally, or in experienced dancers after dancing on hard floors (Malone and Hardaker, 1990:360). Medical factors that increase the risk of stress factors include inadequate nutrition, delayed menarche, secondary amenorrhoea and anorexia nervosa (Hamilton, 1988:168; Khan et al., 1995:348). Other predisposing factors to stress fractures in the foot are a Morton's foot, a cavus foot with a high rigid arch and anterior impingement of the ankle (Hamilton, 1988:169). Stress fractures are most frequently seen in the neck of the second metatarsal when the second metatarsal is longer than the others, and in the demipointe position when most of the weight of the body rests on the second metatarsal. Other sites of stress fractures are the base of the second metatarsal, the other metatarsals, the distal isthmus of the fibula, the tarsal bones, the medial sesamoid, the third metatarsal shaft, the navicular and the sustentaculum tali (Malone and Hardaker, 1990:360; Milan, 1994:126; Quirk, 1994:130).

- Forefoot sprain – this condition is unique to ballet dancers dancing en pointe. To resist dorsiflexion the fourth and fifth metatarsals have strong plantar ligaments, but weak dorsal ligaments. Some dancers, while dancing en pointe, stand past the pointe position so that they are dancing on the dorsal side of the foot, reversing the forces on the joints so that the dorsal capsules are placed under tension and the plantar surface is compressed. In this position the dorsal capsules are easily sprained or torn (Hamilton, 1988:151).

- Sesamoiditis - this is inflammation of the sesamoid bones on the plantar aspect of the first metatarsophalangeal joint (Hutson, 1990:159) and occurs after landing incorrectly after jumping onto the ball of the foot. The medial sesamoid is most commonly affected (Quirk, 1994:131). Forcing turnout leads to excessive load on the sesamoid and may result in sesamoid injury (Khan et al., 1995:348). Other causes of sesamoiditis are contusion, sprain of a bipartite sesamoid, stress fracture, osteonecrosis, osteoarthritis and entrapment neuropathies adjacent to the sesamoid (Hamilton, 1988:171).

- Plantar fasciitis – plantar fasciitis is defined as inflammation of the plantar fascia where it attaches proximally to the medial tubercle of the calcaneus (Marshall, 1988:177). The plantar fascia becomes taut with dorsiflexion of the metatarsal joints where the metatarsal heads are depressed thus elevating the medial arch. Excessive stress is placed on the plantar fascia by continued demipointe and rolling of the foot (Milan, 1994:126).

- The hallux (the great toe) -
  - Bunions – when standing en pointe most of the body weight is transmitted through the big toes, which are supported by the neighboring toes. It is considered that a normal foot should not develop bunions as a result of ballet but dancing en pointe could increase the deterioration of a bunion (Quirk, 1994:132). Hallux valgus (lateral deviation of the great toe) can occur due to congenital metatarsus primus varus (an excessive angle of the first metatarsal toward the midline) (Reid, 1992:147: Reider, 1999:266). Acquired hallux valgus can be the result of an excessive rearfoot valgus that compensates with subtalor pronation and an excessive abduction force on the first metatarso-phalangeal joint (Khan et al., 1995: 347; Subotnick, 1999:128).
  - Hallux rigidus (osteoarthritis of the first metatarso-phalangeal joint) is an acquired condition and can be caused by repeated demipointe and en pointe dancing (Khan et al., 1995: 347; Milan, 1994:125).
  - Nail problems - discolouration, thickening and deformity, bleeding and loss of the nail all occur due to pressure on the nail while standing en pointe (Quirk, 1994:132).
  - Fractures – these are common especially after a faulty landing or a direct insult to the toe. They may occur as either a crush or an avulsion fracture (Milan, 1994:126).

2.7 CAUSES OF BALLET INJURIES

According to Rist and Kennedy (1986:1) dance injuries can be divided into two categories – overuse injuries and traumatic injuries. Other causes of injuries will be discussed under the headings: twisting; fatigue; partnerships; bad teaching; environmental; difficult choreography; stretching; jumping and pointe work.

2.7.1 Overuse injuries

- *poor technique* – incorrect technique may be a major cause of injuries among ballet dancers (Khan et al., 1995:342). This may occur when the dancer has not corrected the alignment of the body and places strain on a weak set of muscles (Rist and Kennedy, 1986:1). Lack of technical knowledge could also fall into this category where young dancers are more prone to injury when they try to put into effect the technique they are in the process of learning (Howse, 2000:74). Professional dancers are also at risk when they take short cuts on the correct ballet technique. This is more likely to happen when these fully trained dancers are tired or are dancing in sub-optimum conditions (Howse, 2000:74).

- *Repetition* – this is used to perfect the detail of a specific movement and leads to fatigue (Rist and Kennedy, 1986:1). Sohl and Bowling (1990:318) found that repetitive movements in rehearsal caused 7% of injuries.

- *Structural variation* – a growing dancer often fails to make body adjustments and realign the centre of weight during periods of growth (Rist and Kennedy, 1986:1). This is important as the dancers' posture is then not correct and injuries are more likely to occur as a result of compensations and faulty technique. Certain bodies are more prone to injury due to structural variation. According to Gelabert (1986:184/5) ballet dancers with an extra long spine may have limited hyperextension of the lower back because their lumbar vertebral bodies are proportionally larger when compared to their intervertebral discs, making it more difficult to achieve the high extensions required in ballet. These dancers also have less flexible backs due to having shorter, thicker and less flexible ligaments and tendons. Dancers with short spines and narrow hips are less able to achieve adequate turnout and hip extension (Gelabert, 1986:186).

- *Muscular imbalance* – this is where an over-developed set of muscles has an under-developed set of opposing muscles (Rist and Kennedy, 1986:1). Some literature regarding ballet injuries suggests that ballet is unique among sports due to its inherent bilateral development and symmetrical balance, resulting in efficient muscle power and coordination (Reid et al., 1987:347). Contrasting this are the results of Hamilton and Hamiltons' study (1992:270), which found that ballet dancers had a significant reversal of strength between the adductors and abductors of the hip as compared to the norm. They (Hamilton and Hamilton, 1992:270) also found that both male and female dancers had increased hip external rotation with an associated loss of internal rotation. This resulted in a range of motion that was 11% less than normal in the male dancers. The female dancers had increased abduction of the hip with a loss of adduction, also resulting in a range of motion that was 10% less than normal. The total range of motion of the talocrural joint was greater than normal in both male and female dancers, despite a loss of dorsiflexion related to muscular imbalance (Hamilton and Hamilton, 1992:270).

- *Equipment* – this can be a cause of injury when floors are too hard or shoes are too soft and fail to protect or give the support that is necessary to the foot (Malone and Hardaker, 1990:360; Reid, 1987:233; Rist and Kennedy, 1986:1). Pointe shoes consist of a hard back / sole that is made of leather to provide traction and grip the floor. The vamp is the front of the shoe that covers the dancers' toes. The length of the vamp should be determined by the length of the dancers' toes. The block, made from layers of burlap, cardboard and paper that has been saturated with glue, comes in a variety of widths and should allow the toes to spread sideways while supporting the metatarsal arch firmly and comfortably (Haupt, 1997:168). They are covered with satin that absorbs sweat and provides traction (Milan, 1994:127). Right and left shoes are identical. Ribbons wound around the ankle hold the shoes in place (Quirk, 1994:132). One pair of pointe shoes is often worn out after only one performance, but they are often worn when soft, reducing the support provided. The important characteristics of pointe shoes are often ignored for aesthetic reasons leading to blisters, calluses, corns, digital abscesses, nail deformities and abnormal biomechanics higher up within the kinematic chain (Milan, 1994:127).

- *Postural defects* – repeated bad habits and awkward physique lead to the development of injuries (Rist and Kennedy, 1986:1). Most ballet dancers are not anatomically perfect for dance so there are physical limitations that play a part in preventing the development of perfect technique. A weakness, such as a lack of turnout, can become problematic (Hamilton, 1986: 61; Howse, 2000:74). Dancers who are exceptionally supple are prone to suffer from injuries like sprains, dislocations and impingement syndromes if their muscles are not strong enough to control the excessive movement of their joints. Less supple dancers are more likely to suffer from muscle pulls and tendon strains (Hamilton, 1986:64).

2.7.2 Traumatic injuries

These are caused by a sudden and unexpected accident. Ballet movements are planned and rehearsed so these injuries are rare (Quirk, 1994:123), but may occur in ballet dancers after falling or being dropped during partnerships. The most common traumatic injury in ballet is the sprained ankle (Quirk, 1994:124).

Other causes of injuries can be defined as:

2.7.3 Twisting

Twisting is a form of rotation where one part of the body turns around the central axis of the body while the other part remains still (Rickett-Young, 1996:73).

2.7.4 Fatigue / Insufficient Rest / Overwork

Sohl and Bowling (1990:318) found this to be the cause of 38% of injuries. Although dance is considered a performing art its athleticism cannot be ignored. Students may take several 60 to 90 minute classes each day in addition to daily performances or rehearsal schedules (Malone and Hardaker, 1990:356; Weisler et al., 1996:754). Some ballet students may dance from 18,2 hours per week, up to 25 hours per week, with 4,8 hours per week of stretching while supplementing their ballet dancing with other physical activity (Reid, 1987:233; Reid et al., 1987:349). Professional ballet dancers dance on average 8 to 10 hours a day, 6 days a week (Kirkendall et al.1984: 208; Micheli, Gillespie and Walaszek, 1984:207). This may increase to roughly 70 hours per week as performances approach with theatre rehearsals and performances (Kirkendall et al.1984: 208).

In addition, many dancers cross-train, taking additional classes in modern, jazz or ethnic dance (Malone and Hardaker, 1990:356).

2.7.5 Partnerships

Injuries can occur when training for partnerships, as boys often have underdeveloped torso strength and technique, so injuries occur when partners are dropped, lifted incorrectly or lifts are badly timed (http://www.informedparent.com, 2003). Male ballet dancers can also develop shoulder injuries from frequent or unaccustomed lifting and poor catching techniques (Sohl and Bowling, 1990:319). Weak dancers develop acute muscle / tendon strains while lifting, especially while lifting out of balance or with a hyperlordotic back (Micheli, 1983:479).

2.7.6 Bad teaching

Injuries occur when teachers fail to appreciate the anatomical limitations, weaknesses or technical faults of a dancer. Significant problems can also develop when children are put en pointe too young or they are pushed to take exams for which they are not yet ready (Howse, 2000:74).

2.7.7 Environmental

The dancer usually has no control over environmental causes of injury. Experienced dancers are more able to recognise potential dangers and try to improve or correct the defect (Howse, 2000:75). According to Howse (2000:75) environmental causes can be divided into subsections:

- Inadequate facilities – this particularly applies to a lack of daily class opportunities where dancers perform shows without adequate preparation earlier in the day.

- Temperature – the dancer should not become chilled before, during or after a class, as muscle injuries are far more likely to occur if the dancer is inadequately warmed up. Cool temperatures make it difficult to warm up or stay warm (Milan, 1994:127). Excessively high temperatures cause complications with excessive sweating, dehydration and muscle cramps, exhaustion or heat stroke (Milan, 1994:127). Sohl and Bowling (1990: 318) reported that inadequate warm-up or cold resulted in 14% of ballet injuries.

- The floor – according to Sohl and Bowling (1990:318), 25% of ballet injuries were caused by unsuitable floors. The most important properties of dance surfaces are resiliency, surface friction and shock absorption (Milan, 1994:127; Seals, 1983:557). Many modern theatres and studios are not purpose-constructed and so the underlying foundation for the floor is reinforced concrete. The lack of spring in the floor can cause many injuries, especially overuse injuries – foot problems, lumbar spine injuries, muscular problems around the tibia and metatarsals which can lead to stress fractures, peripatellar pain, ankle sprains, tendonitis in the leg, ankle and foot, and shin splint syndromes (Howse, 2000:75; Micheli, Gillespie and Walaszek, 1984:207; Milan, 1994:128; Seals; 1983:557).

  The occasional performance may be carried out on an unsuitable floor provided the floor is covered with two layers of specially cushioned vinyl. The surface of the floor is also extremely important (Howse, 2000: 76). Resin is used as a coating on floors that are slippery. When resin is overused and the floor is not cleaned regularly, irregular and uneven patches of resin develop. This can result in the dancer finding their foot stuck to the floor with disastrous consequences if they are in the process of turning, as serious injuries can occur at the knee or ankle (Howse, 2000:76).

  The floor should have adequate shock absorbency to provide sufficient energy return to the dancer, not too much to cause early fatigue or too little (too firm) that the dancers' impact energy is absorbed by the dancers' lower extremities leading to fatigue or injury (Milan, 1994:127; Seals, 1983:557).

Classical ballet includes high impact movements that result in high frequency impact with the floor surface. The ideal dance surface is one that satisfies most of the requirements, enhances the performance and minimizes the fatigue of the dancer, while allowing the dancer to train for longer periods of time without injury (Milan, 1994:127; Seals, 1983:558).

2.7.8 Difficult choreography

According to Sohl and Bowling (1990:318) 12% of injuries are caused by difficult choreography. In the search for something completely new, choreographers can embark on routines that are very awkward and are incapable of being performed with any type of established technique. The dancers may become injured from trying to develop a new technique in order to carry out the required routine or the injury might result from the sudden unaccustomed use of an area of the body (Howse, 2000: 75; Quirk, 1983:509). Solomon et al. (1995), as cited by Bronner and Brownstein (1997:93), found that injuries may peak as new or unfamiliar repertory is rehearsed and introduced in performance.

2.7.9 Stretching

Ballet dancers stretch continuously in order to increase their height of leg, range of motion, to become supple and to overcome stiffness. Injuries can occur while stretching if stretching techniques are incorrect, resulting in damage and pain to the muscles involved. Ballistic stretching, a forceful bouncing type of stretch (Gelabert, 1986:188), that is commonly used by poorly trained dancers tightens muscles and does not elongate them. Excessive stretching tears muscle fibres leading to bleeding and scar tissue formation. This eventually produces hard adhesive tissue that renders muscle inelastic (Gelabert, 1986:188). Overstretching certain muscle groups and leaving out others leads to muscular imbalances (Gelabert, 1986: 188; Hamilton, 1998:163).

2.7.10 Jumping

Repetitive jumping and landing can cause knee, heel, and tendon problems (http://www.informedparent.com, 2003), especially after landing incorrectly. Biomechanical problems are exacerbated on jumping, especially in grand allegro, and can contribute to injury (Khan et al., 1995:346).

2.7.11 Pointe work

Injuries may occur in pointe work due to the position of the foot en pointe where the entire foot is placed 180° to the tibia. If balance is lost, sprains and strains of the ankle may occur. Blisters, calluses, corns, digital abscesses, nail deformities and abnormal biomechanics higher up within the kinematic chain may occur if pointe shoes are ill fitting or too small (Milan, 1994:127). Many young girls start dancing en pointe before the age of 11 when there is insufficient bone development, strength or dancing skill to perform this technique. Dancing en pointe is a major contributing factor to injury in the foot, ankle and the big toe (Reid, 1987:234).

2.8 PERPETUATING FACTORS

Factors that can perpetuate injuries in ballet dancers may fall under the technique of ballet. Many ballet movements, although they look artistic, require the dancer to assume positions that are abnormal (Reid, 1987:233).

Quirk (1983:514) stated that a sports physician could not begin to treat dancers effectively without an intensive study of the technique of dance, due to the distinct differences between sport and ballet injuries. For this reason treatment of the dancer needs to be directed at the underlying technical faults (Khan et al., 1995:355).

2.8.1 Turnout

The visual effects of ballet are enhanced by working the lower leg in maximum "turn out" (external rotation) (Credico and Davis, 1999:43). A correct turnout allows the dancer to face the audience while having the lower extremities appear in profile and the medial borders of the feet in line with the coronal plane (Milan, 1994:122). Ideal turnout is defined as external rotation of both lower extremities so that the longitudinal axes of the feet are rotated 180° away from one another (Gilbert, Gross and Klug, 1998:339). The standard angle of turnout has increased from 90° in the 17th century to 180° today because of aesthetic appeal (Coplan, 2002:580).

The reasons for using turnout are:

- Balance – there is greater 3-dimensional contact with the floor when standing on one leg (Haupt, 1997:200).
- Leg elevation - the leg can be lifted higher in the abducted position as the greater trochanter no longer strikes the outer wall of the pelvis (Quirk, 1994:123).

- Greater range of motion at the hip joint (Credico and Davis, 1999:43).

- Elegance – for a greater purity of line as seen in arabesques and attitudes (Haupt, 1997:200)

According to Howse (2000:54) three constraints can limit turnout at the hip:

- The *hip joint bone configuration* produces an absolute limitation in the possible range of movement. The bone configuration is made up of the depth of the acetabulum, the angle at which the head and neck of the femur are set on the femoral shaft, and the angle at which the femur is set into the pelvis.

- The *capsule and various ligaments* surround the hip joint. The elasticity of the "Y" shaped ilio-femoral ligament holds the femoral head in place (Rist and Kennedy, 1986:52). The other ligaments that are involved are the ischio-femoral and the pubo-femoral ligaments. Tightness within these structures limits turnout, especially after puberty, as the fibrous tissue of which they are composed becomes mature and less elastic (Howse, 2000:55). The age at which dance training begins plays a role because if the Y-shaped ligament is gently stretched at an early age it will become more elastic (Rist and Kennedy, 1986:52).

- *Muscular tightness* can play a role in limiting turnout. The muscles involved are usually the adductors (adductor magnus, longus and brevis, gracilis and obturator externus) (Howse, 2000:55; Moore, 1999:537). Gluteus maximus, medius and minimus are also involved in turnout, and along with the adductors they provide strength and stability to the pelvis (Rist and Kennedy, 1986:54). Other muscles that play a vital role in controlling and maintaining turnout are a group of deep external rotators. This group is made up of the obturator internus and externus, gemellus inferior and superior, quadratus femoris and piriformis (Moore, 1999:550,556) and they are especially active in adage positions to second where the hip is abducted. The sartorius muscle works with these deep rotators in the second position (McCormack, 2001:36).

The body, by working in the turned out position, is placed in an unnatural position, beyond the anatomical confines of the feet, ankles, knees, hips and back (Credico and Davis, 1999:43). Turnout angles for the five classical ballet positions are, on average, 13 to 17° more than the sum of bilateral hip external rotation (Gilbert, Gross and Klug, 1998:346). Turnout should occur 60% from the hips, and 40% from joints below (Credico and Davis, 1999:43). Ideal turnout involves 90° of external rotation at each hip. To achieve adequate turnout, 50 to 70° rotation occurs at the hip, 10° at the knee, 12° of tibial torsion occurs, and there is abduction of the forefoot at the midtarsal joint (Fu and Stone, 1994:295). Thus turnout is the sum total of the entire legs external rotation (Hamilton, 1986:64).

According to the kinematic chain principles, lower limb joints are linked together in a series, in such a way that the motion of one of the joints in the series is accompanied by motion at an adjacent joint (Norkin and Levangie, 1992:69). The joints of the lower limb therefore form a closed system during weight bearing. Any change in function of a joint will cause a change in function of a joint either immediately adjacent to the affected joint or at a distal joint (Norkin and Levangie, 1992:69). It is for this reason that it is important that ballet dancers develop their turnout symmetrically since a restriction in hip external rotation of one hip will exacerbate symptoms in the kinematic chain along the restricted side (Reid, 1988:297).

Few dancers are able to achieve this ideal turn out without making compensations at the pelvis, lumbar spine, knee, ankle and foot joints (Coplan, 2002:580; Gilbert, Gross and Klug, 1998:339). Therefore, according to the kinematic chain principles, the main compensations that are related to this hip positioning are: anterior pelvic tilting, increased lumbar lordosis; excessive external tibial rotation and excessive subtalor joint pronation (Gilbert, Gross and Klug, 1998:339).

The three main compensatory techniques used to increase turnout are the anterior tilting of the pelvis, screwing of the knee and rolling in of the feet (Coplan, 2002:580; Gilbert, Gross and Klug, 1998:339). By tilting the pelvis anteriorly greater external rotation can occur at the hip due to the shape of the acetabulum as it is deeper posterosuperiorly than posteroinferiorly. Screwing of the knee involves placing the feet at 180° with the knees bent, then forcefully straightening the knees without moving the feet. This places great stress on the knee and can lead to injury. Rolling in of the feet involves forced pronation of the foot with lowering of the longitudinal arch. The extrinsic muscles of the foot are then overworked to stabilize the longitudinal arch, predisposing the tendons to injury such as shin splints, tendinitis and plantar fasciitis. The medial structures of the foot and knee may also be strained and cause pain (Coplan, 2002:580/1).

Injuries have been causally associated with improper turnout and the resultant compensations. These injuries are thought to occur most frequently at the tibiofemoral joints and patellofemoral joints and less frequently in the back, leg and foot, resulting in medial collateral ligament irritation, medial meniscal tears and patellofemoral joint pain (Gilbert, Gross and Klug, 1998:339). Other common injuries caused by excessive twisting at the knee, ankle and foot are symptomatic hallux valgus, pes planus, cuboid syndrome, plantar fasciitis, sesamoid problems, posterior tibial tendinitis, achilles tendinitis and medial capsular strain of the knee (Credico and Davis, 1999:43; Khan et al., 1995:345).

Friction between the floor and the foot can provide a small amount of extra "passive" turnout to the whole leg producing rotation between the knee and the foot (Howse, 2000:55). This "over turn-out" is beyond the degree of turnout that is available in the hip joint. It may be due to lack of muscular control of turnout or a limitation of the degree of turnout required by ballet technique. Very few dancers have flat turnout (180°) and by forcing the legs and feet into that position they create a false position, which is insecure and uncontrolled (McCormack, 2001:36).

Consequences of "over turn-out" are (Howse, 2000:187):

- Forward pelvic tilt with an increase in the lumbar lordosis
- Weakening of the trunk muscles (especially the abdominal muscles)
- Increased rate of injury within the lumbar spine, including stress fractures.
- General sequential weakening of various muscle groups.

The lower limit of external rotation of the hip for classical ballet is 45° to 60° (Howse, 2000:190; Micheli, Gillespie and Walaszek, 1984:199).

Dancers who are unable to achieve the ideal turnout position should be encouraged to use "functional turnout". This is simply using the external rotation that is available at the hip joints rather than obtaining the illusion of ideal turnout with excessive lower extremity joint compensations. In this position the centre of the knee should be kept over the midline of the foot limiting excessive tibial rotation. Equal weight should be kept over both feet ensuring that turnout is not forced more in one extremity than the other. The weight should be evenly distributed among the calcaneus, the first and the fifth metatarsal head limiting pronation of the feet (Gilbert, Gross and Klug, 1998:340).

2.8.2 The Plié

The plié and its' correct execution is the basis to ballet class and classical technique. It is the bending of both knees in the weight-bearing position where the weight is equally distributed through both legs, therefore the amount of flexion of each knee is equal.

During a plié turnout should be well controlled, holding the knees over the toes and the weight over the forefoot and front of the heel. During a demiplié the knees flex as far as the achilles tendon allows with the heels still on the floor and a feeling of lifting rather than descending. This position is used in all springing movements, relévés and jumps for shock absorption. This demiplié becomes problematic when the achilles tendon is long as knee strain may occur, and when the achilles tendon is short where there is less shock absorption. The grand / full plié is executed by allowing the heels to leave the floor. This position is potentially harmful if the dancers' knees are incorrectly aligned or if the dancer is working in a position above her maximum turnout (McCormack, undated: 13).

2.8.3 Sur les pointes

To dance en pointe is to dance with the foot, weight bearing, at 180° to the tibia, in the full equinus position on the tips of the distal phalanges (Micheli, Gillespie and Walaszek, 1984:200).

Marie Taglioni was the first ballerina to dance en pointe in 1832. Since then the pointe shoe has evolved from a soft satin slipper with a leather sole to a shoe that allows the dancer to perform more difficult manoeuvers (Cunningham et al., 1998:555). Unlike other athletic shoes ballet footwear is not designed to provide foot stability or absorb shock. The body relies on the lower extremity for this function (Milan, 1994:127).

The ballerinas' point of stability is unnatural as she bears all her weight on the tips of her toes in the block of her shoe. The beautiful line of the ballerinas' foot is achieved by the limits of plantar flexion of the ankle, subtalor, transverse, tarsal and midtarsal joints. The dorsal ligaments of the foot and ankle are then preloaded which places the lower extremity in a highly vulnerable position if balance is lost (Credico and Davis, 1999:43). This position, known as the loose packed position, has a high risk of ligament and capsule injury due to the lateral movement of the ankle that is available when the anterior part of the talus moves out of the intermalleolar space (Korporaal, 2002:3).

Ballet dancers who have a natural tendency towards hallux valgus seem to deteriorate more quickly as a result of dancing en pointe (Quirk, 1994:132).

2.8.4 Body Weight

Ballet dancers are unique in that they have aesthetic as well as athletic demands to fulfill. It has been a requirement of ballet dancers, for the last 150 years, to maintain an exceptionally thin, sylph-like body while still maintaining technical proficiency and strength (Benson et al., 1989:58). This attitude begins in ballet schools and is perpetuated through ballet companies where leanness bordering on skeletal is viewed as the ideal body type (Reid, 1988:305). To maintain this appearance the dietary intake of the ballet dancer is usually restricted quite drastically. The nature of training of ballet dancers does not allow them to expend enough energy to maintain a low body weight while consuming the caloric intake of endurance sports (Benson et al., 1989:58).

Benson et al. (1989:58) reported on a survey performed by Druss on Body Image and Perfection in Ballerinas. Druss found that the main concerns of ballet dancers were weight and diet, and that they consumed less than 1000 kcal/day, while dancing 6 hours a day, 6 days a week. This preoccupation with weight can lead to eating disorders (Benson et al., 1989:58; Hunter, 1994:27). Surveys of professional ballet dancers in America, Russia, China and Western Europe have shown that women's weight in ballet ranges from 10 to 15% below their ideal body weight for their height (Hamilton, 1998:58). One such study, performed in the United Kingdom, used the body mass index (weight [kg] divided by height [metres] squared) as a measure of adiposity. This study determined that the mean values for body mass index in dancers was lower than the mean values for the general population for both women and men in the same age groups (Bowling, 1989:732).

The American Psychiatric Association weight criterion to diagnose anorexia nervosa is 16% below ideal body weight (Hamilton, 1998:58). This supports the suggestion that there is an increased prevalence of anorexia among female ballet dancers (Benson et al., 1989:58). A survey conducted by Benson et al. (1989:58) found that 69% of the 49 ballet dancers involved had an intake of less than 70% of the Recommended Dietary Allowance for key nutrients. Of the 45 participants completing the study, 33% experienced irregular menses or absent cycles during the study period of 6 months. It was found that the dancers with irregular or absent menses spent more days injured with severe injuries, they had a greater number of bone injuries, their injuries prevented them from doing ballet and required a physicians' visit more so than the ballet dancers with regular menses.

Eating habits and an inadequate intake of certain nutrients may either predispose injury or impede recovery from injuries (Benson et al., 1989:59; Hamilton, 1998:155; Hunter, 1994:27). An inadequate intake of calcium may be responsible for the high incidence of stress fractures among ballet dancers, along with a decrease in bone mass. Ballet dancers have also been found to suffer from subclinical iron deficiencies, which impairs energy production resulting in early fatigue that can cause musculoskeletal injury (Benson et al., 1989:59). It has been suggested that caloric deprivation with long hours of training results in fatigue from glycogen depletion, which may also result in musculoskeletal injury (Benson et al., 1989:59). Dieting, and weight fluctuations interfere with bone density, increasing the risk of stress fractures and osteoporosis (Hamilton, 1998:155; Hunter, 1994:27). Inadequate food intake, laxative and diuretic abuse and vomiting can trigger muscle spasms (Hamilton, 1998:155).

Low body fat (low body mass index) or weight may be related to hormonal change and menstrual disorders. There is a high incidence of menstrual disturbances among female ballet dancers, such as delayed menarche, secondary amennorhea, anovulatory cycles and irregular cycles, leading to bone density loss and oestrogen decrease. Nutritional deficiencies, such as low caloric intakes and constant dieting, may be partly responsible for this, as well as strenuous exercise (Benson et al., 1989:58; Hamilton et al., 1989:266; Hamilton and Hamilton, 1992:269). Nonmenstruating ballet dancers are at a higher risk of developing osteopenia (Benson et al., 1989:59) and stress fractures (Hamilton et al. 1989:265).

2.8.5 Age

Patterns of injury and disability are related to the age, skill of the dancer and the years spent training for and during a career in ballet (Hamilton et al. 1989:266; Micheli, 1983:473).

Upon reviewing the literature, Reid (1988:303) reported that the majority of females begin ballet training between the ages of 4 and 8 (average 6 to 33 years). This amounts to approximately 11 years of training before dancing professionally from the age of 18. Men tend to start training significantly later than women do, between 12 and 15 years of age. The average age for men to turn professional is 19, after approximately 7 years of training (Hamilton et al., 1989: 264). By the time the ballet dancer enters a company they may have chronic problems that increase in pain and debilitation as they continue to dance (Reid, 1988:296).

Dancers going through puberty and growth spurts are more susceptible to overuse injuries due to the changes occurring in muscles, ligaments and bones (Reid, 1987:233).

Injuries may differ with a dancers' level of training i.e. if they are pre-professional, college or professional dancers. Treatment for their conditions will also vary, as pre-professional dancers would allow more time off for optimal healing as they have a smaller performance schedule and less financial incentives to perform

(Bronner and Brownstein, 1997:88). Student dancers have been found to suffer more from knee or hip problems; whereas professional dancers are more affected by lower leg problems (Micheli, 1983:473).

A survey performed by Hamilton (1996/7) on 960 dancers found that of the dance students below the age of 24, 47% suffered from chronic injuries, 9% from arthritis, 16% from back injuries, 24% foot injuries, 18% hip injuries and 4% shoulder injuries. From the students over 25 years, 46% suffered from chronic injuries, 17% arthritis, 18% back injuries, 20% foot injuries, 13% hip injuries and 9% shoulder injuries. It was found that 61% of professional dancers suffered from chronic injuries, 22% arthritis, 44% back injuries, 30% foot injuries, 26% hip injuries and 13% shoulder injuries (Hamilton, 1998:148). These results may suggest that the level of dancing, not the age of the dancer, relates to the development of injuries, as the prevalence of chronic injuries was similar between both groups of students, while differing significantly from the professional dancers.

Hamilton et al. (1989:265) found that older dancers (over 30 years of age) reported more injuries, major physical problems and required longer recovery periods than younger dancers. Dancers' flexibility decreases with age. To overcome this stiffness many dancers over stretch which results in discomfort and ache in the muscles (Gelabert, 1986:187).

2.8.6 Gender

According to Hamilton and Hamilton (1992:271) gender differences in injury may be related to the role of the male in ballet where the ability to jump, turn and lift are considered more important than ballet technique. Men start ballet training at an older age and are not required to work en pointe or have the same flexibility and turnout that is required of the female ballet dancers. Female ballet dancers appear to injure themselves while trying to obtain a better technique than their bodies will allow. On reviewing the literature no studies were found that specifically mentioned whether males or females were injured more frequently.

2.8.7 Psychological stress

In the survey performed by Hamilton et al. (1989:266) it was found that male ballet dancers demonstrate more psychological stress than female ballet dancers and non-dancer males.

Most ballet dancers display the "over achiever" personality type where they are extremely dedicated, goal orientated and persevering people, which may contribute toward injury (Hamilton et al. 1989:266).

2.8.8 Structural variation

Structural variations such as femoral anteversion, genu valgus / varum, tibial torsion and pes cavus may predispose the ballet dancer to injury due to the decreased ability of the lower extremity to absorb impact forces (Malone and Hardaker, 1990:360). Ballet dancers with cavus feet run a higher risk of developing overuse syndromes such as flexor hallicus longus tendonitis and osteoathritis of the first metatarsal-medial cuneiform articulation (Marshall, 1988:187). Genu valgum causes difficulties in performing certain movements and may result in patellar and meniscal injury (Hamilton, 1986:66).

2.8.9 Ethnic group

The classical technique of ballet evolved around the typical physique of Caucasians. It is thought that this might predispose individuals of different ethnic groups to be more affected by ballet training, leading to an increase in injury incidence (Gelabert, 1986:187).

Members of the black race tend to have an increased lordosis and a more prominent sacral promontary as compared to Caucasians. The line and harmony of ballet contrasts this. Ballet dancers are taught to decrease their lumbar lordosis by pulling up their pelvis. Genetic structure cannot be changed and these individuals might compensate by hyperextending the hip, which in turn affects the normal curves of the spine (Gelabert, 1986:187).

On reviewing the literature no studies were found that commented on differences in the incidence or prevalence of ballet injuries among different ethnic groups.

2.9 TREATMENT

Studies investigating the frequency with which injured ballet dancers seek treatment suggest that the prevalence of care seeking is high. According to Bowling all 59 dancers who had been injured in the previous 6 months, in a way that affected their dancing, consulted a health professional (Bowling, 1989:733). Similarly Credico and Davis (1999:45/6) reported that of the 21 professional dancers who reported a knee injury in their study on ballet related knee injury, 17 ballet dancers (81%) had sought treatment. Of the 42,2% ballet dancers in Reids' study of ballet students (1987:232/3) who reported chronic injuries, only 35,6% were considered serious enough to seek medical attention.

2.9.1 Type of Treatment

In Bowling's study (1989:733) 76% of dancers consulted a physiotherapist, less than half (47%) a medically qualified practitioner, 29% a masseur, 20% an acupuncturist and 22% an osteopath. Sixty three percent consulted more than one professional. From the 17 dancers who sought treatment in Credico and Davis' study (1999:45/6), the most frequently sought treatment was rehabilitation (8:47%), followed by orthopaedic and bracing (7:41%), physiotherapy and medication (5:29%), taping (4:23%), chiropractic (3:17%), acupuncture and other (2:12%) and injections (1:6%).

2.9.2 Delay in Treatment

One third of the dancers in Bowlings study (1989:233) stopped dancing and rested immediately after being injured. Fifty four percent of the injured dancers carried on dancing as best they could and did not rest at all, 10% rested after a few days and one dancer rested after three to five months. Treatment was delayed in most cases with only 18% of dancers seeing a professional for treatment on the day of injury. Thirty two percent sought treatment the following day, 21% waited two to four days, 24% waited one to two weeks and 6% delayed longer. According to Reid (1987:232/3) when dancers eventually sought treatment their conditions were often chronic and difficult to treat, and the advice given was rest. In his study 32% of dancers had suffered an injury serious enough to result in a loss of more than a week of dancing. Credico and Davis, (1999:45) reported that twelve dancers (71%) reported an interruption in their dancing, with the average time being 3,6 months. For this reason ballet dancers frequently do not report their injuries or seek treatment as they cannot refrain from dancing for a long period as often they are under pressure to perform, there is intense competition, time is lost from training, there is a loss of flexibility and they are unable to continue dancing at the pre-injured level (Fernandez-Palazzi, 1990:259; Sohl and Bowling, 1990: 318).

2.9.3 Treatment Results

Of the dancers involved in Bowlings study (1989:233), 83% found treatment helpful. It was too early to assess the outcome in 11%, and 6% found the treatment unhelpful. Treatment results were favourable for 14 (71%) of the dancers from Credico and Davis' study (1999:45), 3 (18%) had temporary relief, 2 (12%) found the treatment had no effect and 2 (12%) found their injury to be completely resolved.

2.10 INJURY PREVENTION

Suggestions were made by 114 of the dancers who responded to Bowlings' study (1989:733) for the prevention of injury. Technique classes for teachers to make them aware of anatomy and the bodies' limitations were suggested by 50% of the dancers, more careful warm up exercises by 36%, and warmer environments for dancing, 32%. Twenty nine percent suggested less pressure and overwork, 19% suggested better flooring, 19% resident physiotherapist for injury prevention treatment and 18% adequate diets.

Before the dancers in Credico and Davis' study had suffered a knee injury, 8 (38%) of the 21 dancers had practiced preventative exercises. The preventative exercises described were warm-ups and stretches (6), massage (3), weight training (2) and other (1). After their injury, 20 (95%) of the 21 dancers practiced preventative exercises, including stretching (13), warm-ups (12), massage (11), weight training (9) and other (9). These exercises were prescribed pre and post injury respectively by themselves (7, 10), fellow dancers (6, 8), ballet teacher (4, 5), orthopaedic surgeon / doctor (4, 8), physiotherapist (3, 6), chiropractor and physiatrist (1, 1), other (0, 4). Nine of the dancers found these exercises extremely helpful in preventing subsequent injury, 9 found them somewhat helpful, none said they were not helpful and 2 dancers did not respond (Credico and Davis, 1999:45).

2.11 <u>CLASS FORMAT</u>

According to Bowlings' study (1989:732) 32% of injuries occurred during performance, 28% during rehearsals, 16% during classes and 7% said their injuries had a slow onset and so were unsure of when the injury occurred. Various situations were mentioned by 17%.

The central experience of learning to dance is the dance class. Class can either be seen as a preparation for performance, the experience of learning to dance or the principal experience of dancing (Buckroyd, 2000:69). Ballet class prepares the dancers body to meet the physical demands of ballet, as a structured preparation for performance (Malone and Hardaker, 1990:355).

The details of each lesson will vary from teacher to teacher, but the essentials of ballet class will never vary. Ballet classes have been used for 200 years as the foundation for training that precedes ultimately the beauty of movement, strength, endurance, poise, agility and speed (Sparger, 1949:11).

Typical ballet classes run in the following order, for approximately 60 to 90 minutes:

<u>Warm up</u> – a thorough warm up is essential for injury prevention. Warm up increases the body temperature so that nerve impulses can travel more quickly thus increasing muscle contraction and response times. Circulation is also encouraged which eliminates waste products from muscles (Haupt, 1997:222). The warm up should be slow, methodical and gentle. It should focus on stretching the main muscles to prepare them for fast contractions, reduce any muscle shortenings and prepare the heart and lungs for action (Rist and Kennedy, 1986:83). Warm up is a gradual physical and mental preparation for greater physical exertion. It increases the heart rate, the deep temperatures of

the muscles, flexibility of tendons and ligaments reducing the chance of injury and increases blood sugar and adrenalin levels (Rickett-Young, 1996:29).

Barre – with the support of the barre (a wooden railing along the wall), stance, stability of turnout, support of the arm to the side and general perfecting of detail is started. Exercises are repeated to perfect detail of execution (Haupt, 1997:223). Exercises include bending and stretching of the legs. These exercises gradually increase in speed and the height of leg from the floor (Malone and Hardaker, 1990:355). Hip abduction and external rotation are emphasised during barre work (Reid et al., 1987:349). Barre exercises last 25 to 45 minutes (Malone and Hardaker, 1990:355).

Following barre work 5 to 10 minutes are generally used for static stretching, focusing on hip extension, external rotation and abduction (Reid et al., 1987:349).

Centre practice – in centre practice barre exercises are repeated without the use of the barre i.e. unsupported. The purpose of this is to perfect equilibrium and control of turnout (Haupt, 1997:223). These exercises are executed slowly, concentrating on balance, strength and aesthetic line (Malone and Hardaker, 1990:355).

Pirouettes – a step where the dancer turns on one leg only.

Adage ("at ease") – in adage movements are slow, sustained and controlled, incorporating arabesques, attitudes and dévelopés. These are embellished with a great variety of arm, head and body movements to express emotions such as solemnity, melancholy, ecstasy, peace and beauty (Haupt, 1997:223).

Allegro – as defined by The Concise Oxford Dictionary of Music (Kennedy, 1996:14), means "quick, lively and bright". It incorporates all the jumps, steps and movements in the dance vocabulary (Haupt, 1997:224) including petit allegro (small jumps or bouncy springs of minimal elevation), batterie (quick succession of beats) and grand allegro (soaring aerial jumps, leaps and turns, vertical or traveled, while throwing the leg 90° or higher)(Malone and Hardaker, 1990:355).

Pointe work "sur les pointes"- this is the end result of slow gradual training of the whole body: back, hips, thighs, legs and feet. The body is placed so that the weight is lifted upward off the feet, with straight knees and with the dancer standing on the tips of the toes without allowing the foot to sickle or pronate (Khan et al., 1995:342). Pointe work tends to be practiced at the end of class to develop sufficient strength and balance while dancing on full pointe.

2.12 <u>CONCLUSION</u>

The results of studies conducted in countries such as the UK, America, Canada and Australia suggest that the prevalence of injuries among ballet dancers is high. Injuries are often severe enough to limit or prevent dancing and commonly become chronic, producing significant disability. This high prevalence seems to be in part due to the unusual and often extreme physical demands placed on ballet dancers' bodies. The most important causative / predisposing factors seem to be fatigue, inadequate warm-up, unsuitable floors, difficult choreography, and repetition of movements; while significant perpetuating factors include insufficient turnout, incorrect technique and dancing en pointe.

Certain individual factors have been identified as potential risk factors for the development of injuries among ballet dancers. Injuries may differ between the genders due the different roles portrayed in ballet, where men are required to lift and jump high, and women are required to perfect their technique, be extremely flexible and dance en pointé. There is some evidence to suggest that black ballet dancers are more prone to injuries than Caucasians, but no information regarding the relative risk among the other racial groups is available. Poor eating habits and an inadequate diet may result in early fatigue that predisposes musculoskeletal injury and impedes the recovery of such injuries. Similarly a lower Body Mass Index, associated with hormonal changes, appears to be associated with a higher prevalence of injuries. Higher levels of emotional stress are also associated with increased levels of injuries.

The most frequently injured areas of the body are the foot and ankle, the back and the knee while upper limb, neck and head injuries are rare. Overuse injuries are more common than acute injuries.

The level of care seeking for ballet-related injuries is quite high, with the most common sources of treatment being physiotherapy, rehabilitation, orthopaedists and bracing.

South Africa has a very vibrant and growing art culture, in which ballet plays an integral role. However, no epidemiological studies on injuries in ballet have been conducted in South Africa. It is therefore the aim of this study to help establish the prevalence of injuries among ballet dancers in the greater Durban area, the nature and severity of these injuries; and possibly to identify certain factors associated with an increased risk of injury among ballet dancers in this area. A further aim of this study is to determine the extent and nature of care seeking for ballet-related injuries. This information could form the basis for strategies aimed at reducing the prevalence of injuries, as well as for further research.

CHAPTER 3

MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter deals with the collection of data and the research methodology utilised. The statistical analysis process is also discussed.

3.2 STUDY DESIGN

A prospective, questionnaire-based epidemiological study, investigating dance injuries in ballet dancers, was conducted in the greater Durban area.

The data was collected by means of questionnaires (Appendix C: Letter of Information; Appendix J: questionnaire), which were completed by the subjects, under supervision of the researcher.

3.3 DEVELOPMENT OF THE QUESTIONNAIRE

A "focus group" is a qualitative research technique that collects data and insights through group interaction based on topics supplied by the researcher, who takes on the role of moderator (Greenbaum, 2000:3; Morgan, 1997:2,6).

The Treatment Record Questionnaire (Korporaal, 2002), which was utilised for gathering data at various sports related events, underwent face validity testing in the dancing context, prior to the study, by means of a focus group.

In this context, validity refers to the accuracy and trustworthiness of instruments, data, and findings in research, thereby ensuring that future research utilising the particular tool is accurate (Bernard, 2000:46). The components of validity are face validity, content validity, construct validity, criterion validity and external validity. The definitions of these concepts and how they were addressed in the questionnaire:

1. *Face validity*, the simplest type of validity, is determined by agreement between researchers and those with a vested interest in the questionnaire, that ‘on the face of it’ the tool seems valid (Bernard, 2000:49).

2. An instrument has *content validity* when the content of the questionnaire is considered effective, and appropriate enough to be able to assess a particular concept (Bernard, 2000:49). This remained unchanged in the current questionnaire as the function of the focus group was to ensure that the elements portrayed in the Treatment Record Questionnaire (Korporaal, 2002) remained intact, but were reflected in a different context (i.e. dancing).

3. *Construct validity* measures the degree of closeness between the construct being measured and the actual observation made with the instrument, how accurately answers to questions in a scale reflect theoretical predictions of a particular construct (Bernard, 2000: 50).

4. *Criterion / concurrent validity* is measured when a particular tool produces similar results when compared with another tool already known to be trustworthy (Bernard, 2000:51). Predictive validity falls under this category as well. If a tool can predict a future situation accurately it has predictive validity (Mouton, 1996:128).

5. *External validity* measures asks the question as to how generalizable the experiment is, to what populations, settings, treatment variables and measurement variables can the effect as observed in the experiment be generalized (Leedy, 1997:34).

Construct validity and content validity of the questionnaire remained intact as they had been established in the Treatment Record Questionnaire (Korporaal, 2002), and the focus group ensured that the meaning and concepts were apparent. For the purpose of this study only face validity was required due to the type of information the questionnaire was designed to gather.

Face validity is the simplest type of validity, and is determined by agreement between researchers and those with a vested interest in the questionnaire, that 'on the face of it' the tool seems valid (Bernard, 2000:49). This was achieved prior to the study by using a focus group. The aim was to provide insight into question wording and minimise differences in how respondents interpret the questions, thus improving validity and reducing unreliability (Morgan, 1997:26).

Literature suggests that a focus group should consist of 6 to 10 participants (Greenbaum, 2000:4; Morgan, 1997:43). The focus group for this study consisted of ten participants; some from the healthcare profession (a chiropractic student and a physiotherapist), ballet dancers, ballet teachers, the researcher, and a scribe. These participants were enlisted via word of mouth, with 10 respondents coming forward and expressing interest in participating in the focus group.

Before commencing, each participant was required to read a Letter of Information (Appendix G), and sign an Informed Consent Form (Appendix F). At the outset of the focus group each participant was given a copy of the Treatment Record Questionnaire (Korporaal, 2002) (Appendix H) and comment was requested from the participants on how the questionnaire could be modified in order for it to be used to accurately assess ballet injuries.

The questions were discussed in sequential order. If inconsistencies were found or changes proposed, a unanimous vote was required to institute change. At the end of the discussion opportunity was given for comment on the questionnaire. The Treatment Record Questionnaire (Korporaal, 2002) was discussed in terms of it accurately reflecting concepts relating to ballet injuries. Suggestions for change were analysed, and these changes made to the questionnaire, yielding the version used in this study (Appendix J).

The content of the discussions from the focus group will be kept confidential and the focus group will be kept anonymous. The transcripts (Appendix I), documents and video of the proceedings that were made will be kept in a secure area in the DIT Chiropractic Day Clinic and shredded / destroyed after five years.

3.4 ALLOCATION OF PARTICIPANTS

3.4.1 Sampling

A non-probability convenience sampling technique was used in the study. However, on data capture any information omitted on a questionnaire rendered the questionnaire invalid, thus ensuring that only fully completed questionnaires were used.

3.4.2 Sample size

One hundred (100) participants completed the questionnaire. This sample represents at least 15% of the estimated population of ballet dancers in the greater Durban area as (N=610) in KwaZulu-Nalal (Clark, 2003); which according to Robert (2003) is sufficient to draw conclusions that represent the population being studied.

3.5 CRITERIA FOR PARTICIPATION IN THE STUDY

Prior to commencing the research survey the researcher approached the principals of ballet schools in the greater Durban area and requested permission to conduct research at the ballet schools by means of a Letter of Consent (Appendix E).

3.5.1 Inclusion criteria

Participants, selected for the research study by using convenience sampling, underwent a cursory interview with the researcher (Appendix A). Each participant was given a Letter of Information (Appendix C) explaining the research being conducted, a Letter of Informed Consent (Appendix B) and a Letter of Assent (Appendix D) if the participant was younger than 14 years of age.

1. Participants had to be ballet dancers with at least two years of experience (Reid, 1987:231).
2. The participant had to sign the Informed Consent Form (Appendix B), thereby making an informed decision to participate in the research. Parental consent for participants under 14 years of age was obtained by means of signing the Letter of Assent (Appendix D).
3. Participants could be professional or amateur ballet dancers.
4. Most ballet dancers in KwaZulu-Natal are between the ages of five and eighteen years (Clark, 2003). For the purpose of this study ballet dancers were required to be between the ages of ten and fifty years of age (Coplan, 2002:581; Credico and Davis; 1999:44; Reid et al., 1987:349), to allow for greater comparability between this study and studies from outside South Africa.
5. Participants could participate in other styles of dance.

3.5.2 Exclusion criteria

Participants where not excluded for any reason other than not meeting the inclusion criteria.

Questionnaires were excluded if the Informed Consent Form or the Letter of Assent were not signed.

If the patient information details or information on the questionnaire were incorrect or omitted, or the questionnaire was incomplete, the information was not used for the purposes of data analysis in this study.

3.6 DATA COLLECTION AND ANALYSIS

Participants filled out the face-validated questionnaire (Appendix J) with respect to:

- Patient demographics including name, age, race, gender, height and weight
- Years of ballet experience
- Additional recreational activities
- Location of current and previous injuries
- Mechanism of current injuries
- Frequency of injuries
- Clinical impression
- Present and previous treatment received

The data collected from each questionnaire was then used for data capturing purposes.

3.7 ETHICAL CONSIDERATIONS

Access to research questionnaires was limited to the researcher and the researchers' supervisor. The questionnaires were numbered after completion and data was coded so that the association of patient details to their names was inaccessible to the researcher, thus ensuring anonymity and participant confidentiality.

3.8 STATISTICAL ANALYSIS

3.8.1 Introduction

All completed questionnaires were used in the study for the purposes of data analysis.

Statistical Analysis was conducted using the SPSS (version 9) software suite. This Statistical software program is manufactured by SPSS Inc, 444N. Michigan Avenue, Chicago, Illinois, USA.

Various Descriptive and Inferential Statistical techniques were used. In the exploratory stage of analysis descriptive statistical analysis was used, which was applied on all demographic data as well as data from the main body of the questionnaire. The Descriptive procedures used were various tables and graphs and a few summary statistics including but not limited to means, proportions and percentages.

Relationship testing was conducted using Chi-Square Tests and Parametric Hypothesis testing procedures were used for magnitudinal tests. All tests set the type 1 error at 5%, or mentioned differently $\alpha = 0.05$. If the p value as reported was less than 0.05 a significant result was declared and the Null Hypothesis was rejected.

The methodologies applied to the various inferential procedures are listed below:

3.8.2 The Chi-Square Test

H_o: There is no association between both variables.
H_1: There is an association between both variables.

$\alpha = 0.05$
Note: α = probability of rejecting H_o when is true (Type 1: error)
The test statistic is calculated:

$$\chi^2 = \sum((O - E)^2)/E$$

where the observed frequencies are equal to (row total $\times$ column total)/ grand total.

The tabulated value is obtained from Tables = χ^2.

Note: The p-value = the probability of H_o being true.

If the p-value is $< \alpha = 0.05$ then H_o is rejected.

Note that ideally in the Chi-Square Test all cells should be greater than or equal to five, however, if this is not so categories can be grouped. When this is not possible, then Yates' Continuity Correction is used if it is a two by two table and Fisher's Exact Test is used if the table is greater than a two by two table.

3.8.3 The Independent T-Test

The Independent T-Test is used to determine if the population mean from one variable is significantly different to the population mean for another variable.

3.8.3.1 Levene's Test

Levene's Test is used to determine if the population variances are significantly different. If the p value is greater than 0.05 H_0 is not rejected and hence there is not sufficient evidence to suggest the population variances are significantly different. In this case the p value is applied to the equality of variances.

If the p value is less than 0.05, H_0 is rejected and there is thus sufficient evidence to suggest that the population variances are significantly different. In this case the p value is applied to the non-equality of variances.

3.8.3.2 Equality of variances and Non-equality of variances

These tests are used to determine if the population means are significantly different. If the p value is less than 0.05, then H_0 is rejected and hence there is sufficient evidence to suggest that the population means from both variables are significantly different. If the p value is greater than 0.05 H_0 is not rejected and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

The generic methodology for the Independent T-Test is highlighted below:

H_0 : $\mu_k = \mu_l$

H_1 : $\mu_k \neq \mu_l$

$\alpha = 0.05$

Note: α = probability of rejecting H_o when it is true (Type 1error)
The test is two tailed.

The test statistic is:

$$\text{T Test Statistic} = \frac{\bar{\chi}1 - \bar{\chi}2 - 0}{\sqrt{s_1^2/n_1 + s_2^2/n_2}}$$

The tabulated value is obtained from T Tables.

Note: The p-value = the probability of H_o being true.

If the p-value is < α = 0.05 then H_o is rejected.

CHAPTER FOUR

RESULTS

4.1 DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE POPULATION

4.1.1 Sample size

The sample consisted of 100 ballet dancers from within the greater Durban area. The majority (89) of the ballet dancers involved in this study were students, 10 were professional dancers and 1 was a teacher.

4.1.2 Gender distribution

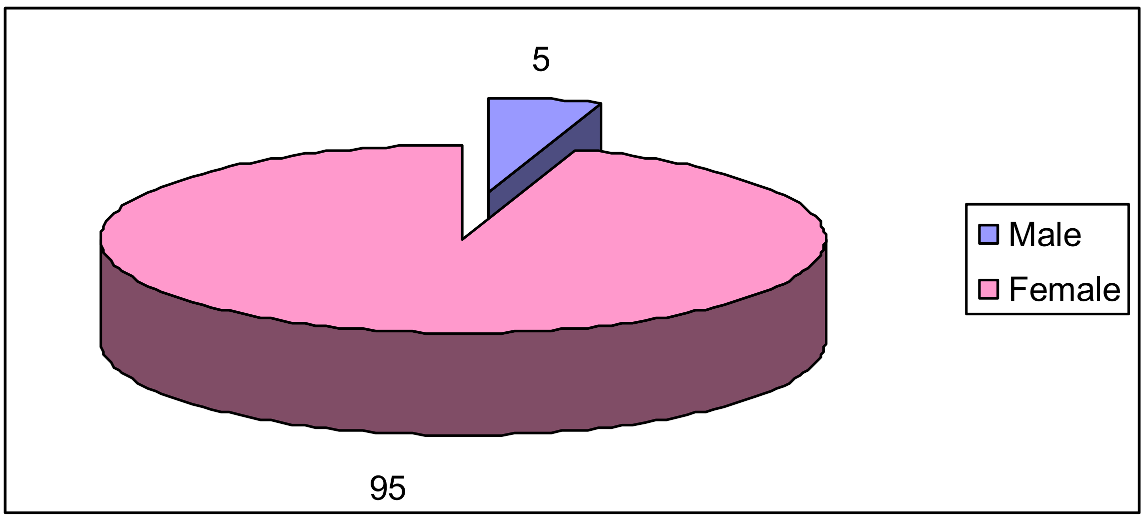

Fig 4.1 Gender distribution of the sample population (N=100)

A total of 100 subjects were included in the study, which consisted of 95 females and 5 males.

4.1.3 Ethnic distribution

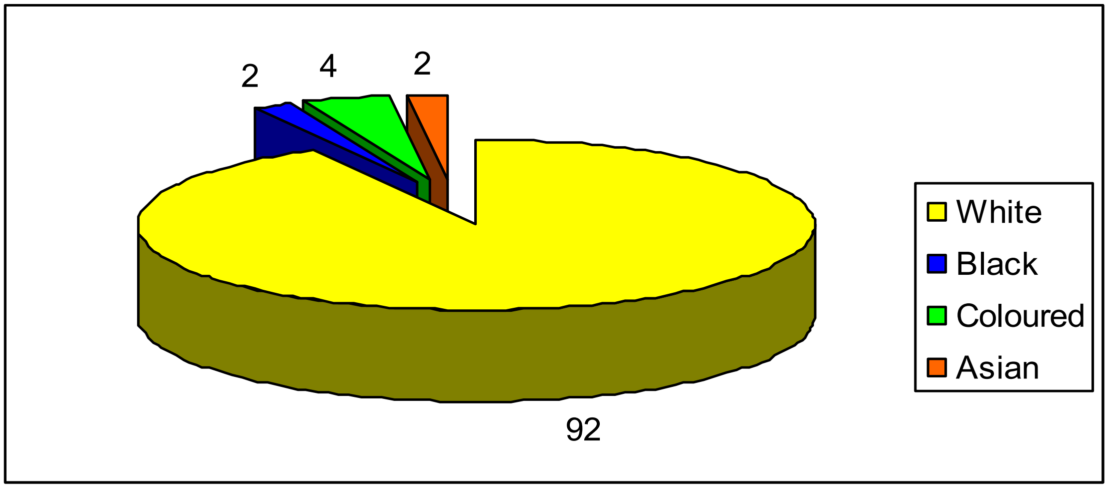

Fig 4.2 Ethnic distribution of the sample population (N=100)

Of the 100 subjects involved in the study 92% were White, 4% Coloured, 2% Black and 2% Asian.

4.1.4 Age distribution

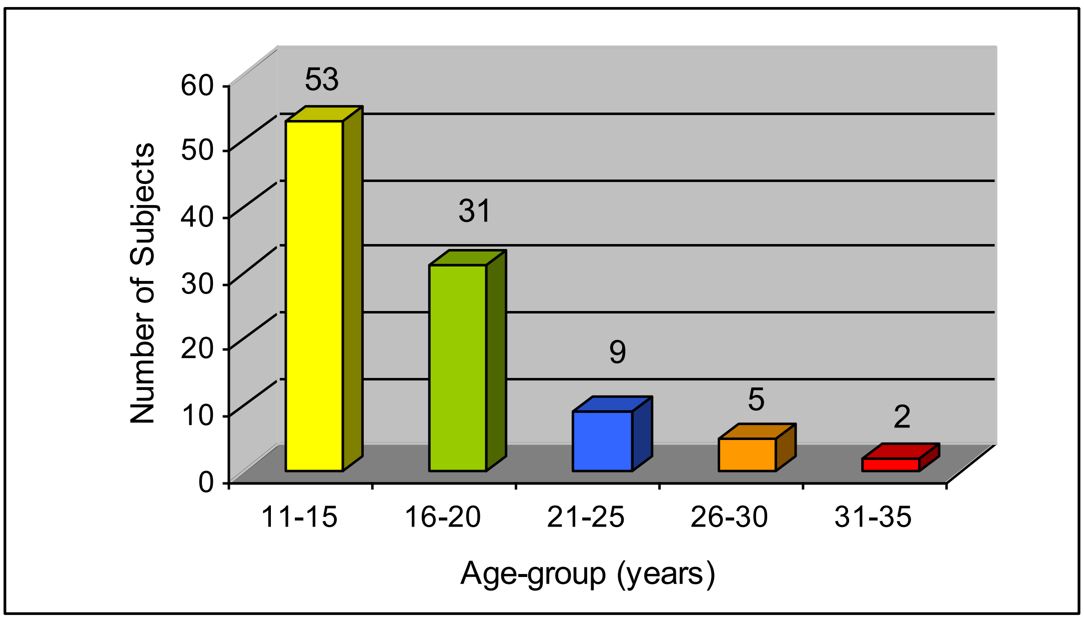

Fig 4.3 Age distribution of the sample population (N=100)

The majority (53%) of subjects were in the 11-15 year old age-group.
The youngest subject was 11 years of age and the oldest was 35.
The mean age was 16.82 years.

4.1.5 Height distribution

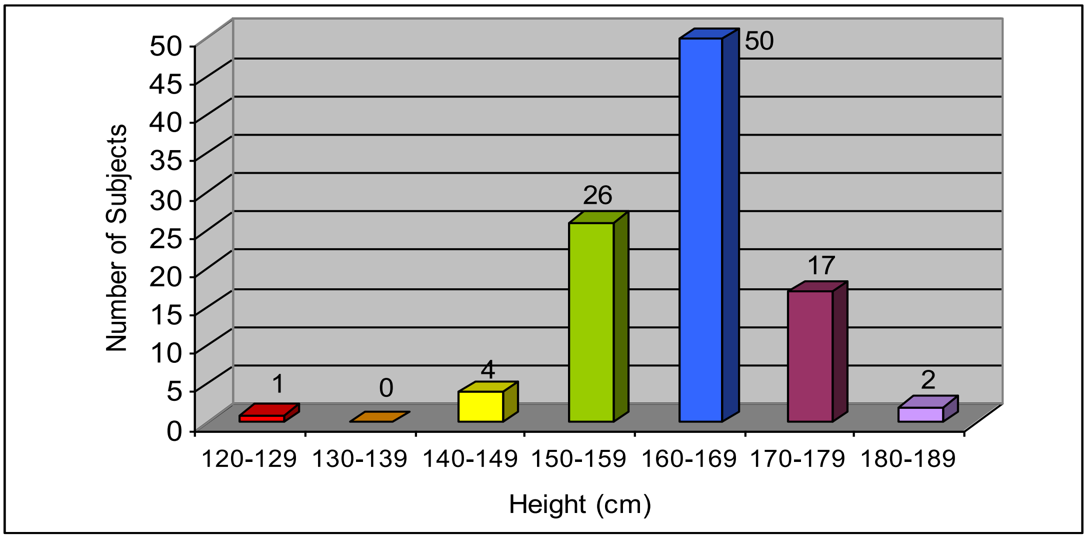

Fig 4.4 Height distribution of the sample population (N=100)

The majority (50%) of subjects measured 160-169cm.

The shortest subject was 125cm and the tallest was 187cm.

The mean height was 162.01cm.

4.1.6 Weight distribution

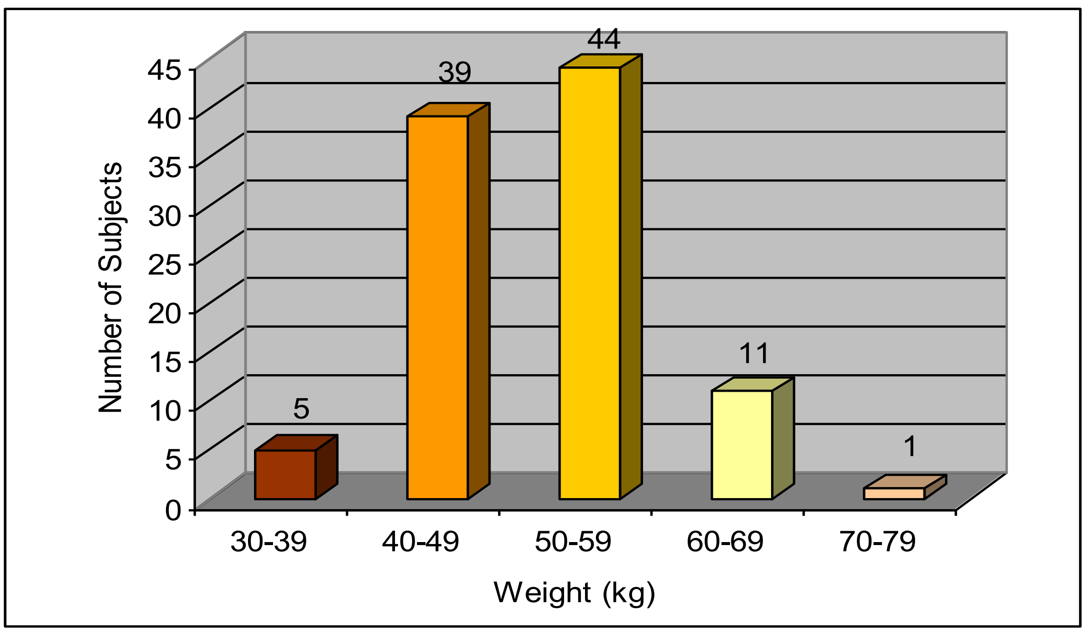

Fig 4.5 Weight distribution of the sample population (N=100)

The majority (44%) of subjects weighed 50-59 kg.

The lightest subject was 30 kg and the heaviest was 72 kg.

The mean weight was 50.49kg.

4.1.7 Body Mass Index

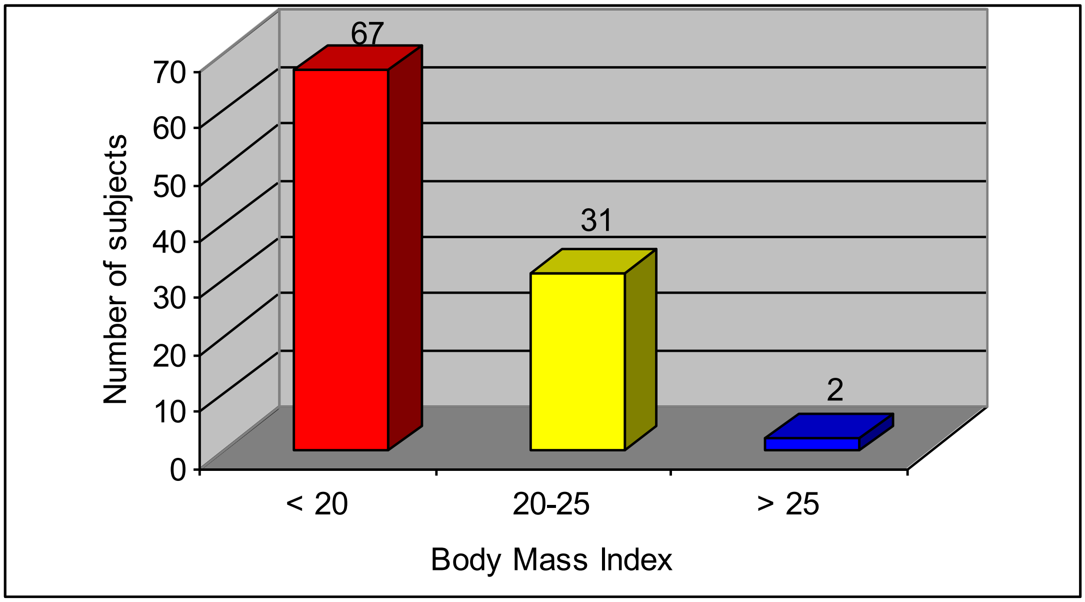

Fig 4.6 Body Mass Index of the sample population (N=100)

The majority (67) of subjects had a Body Mass Index (BMI) of less than 20. The minimum BMI was 13.57 and the maximum 27.52.
The mean BMI was 19.23.

4.1.8 Diet

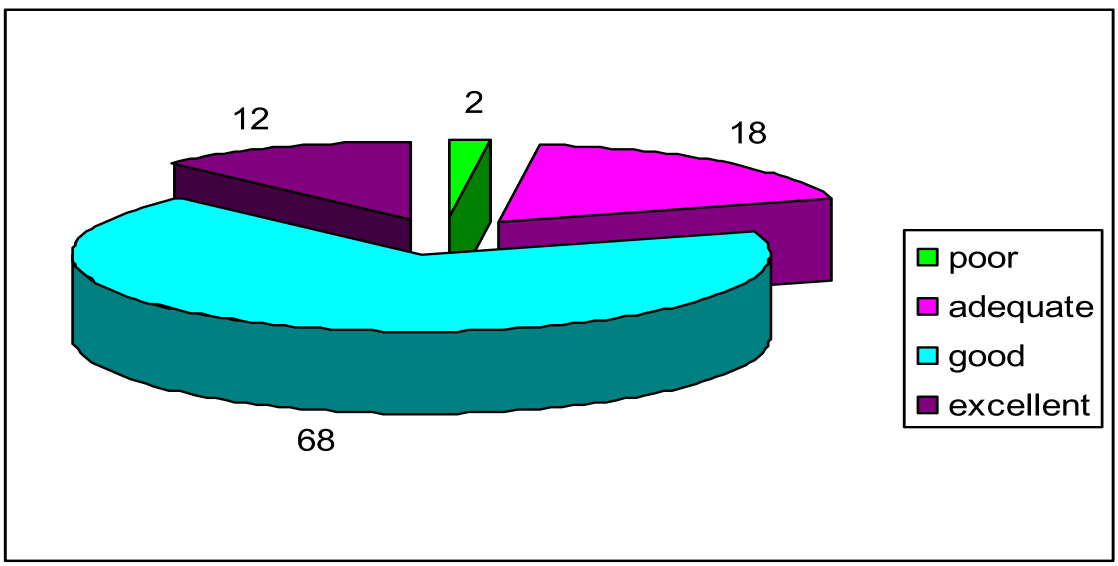

Fig 4.7 Dietary habits of the sample population (N=100)

The majority of ballet dancers (68) reported that their dietary habits were good. Adequate dietary habits were reported by 18, 12 reported excellent dietary habits and 2 poor dietary habits.

4.1.9 <u>Emotional stress levels</u>

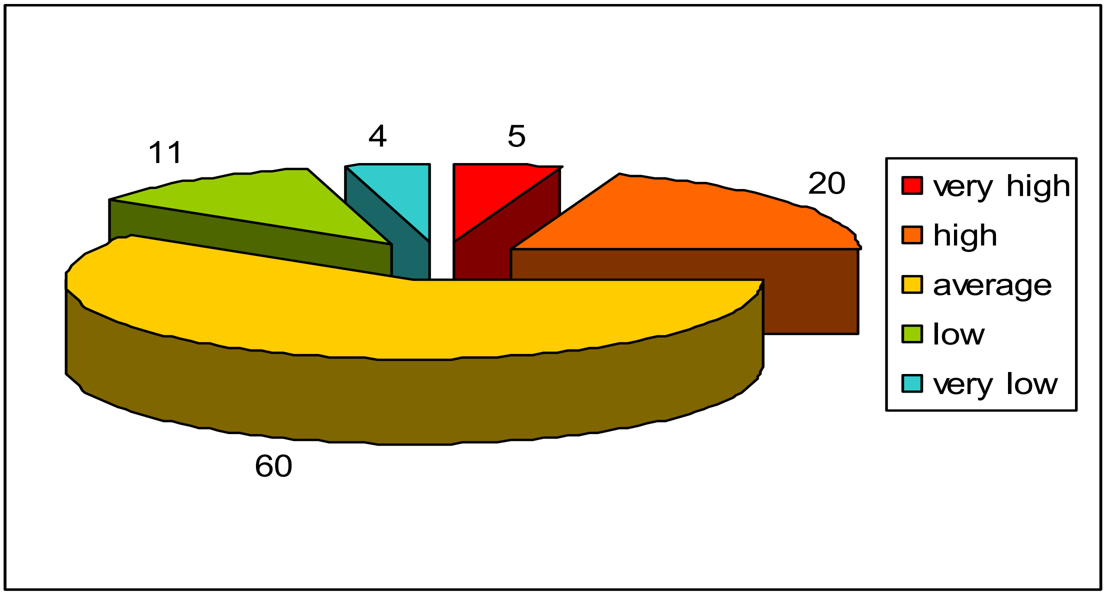

Fig 4.8 Emotional stress levels of the sample population (N=100)

The majority of subjects (60) reported average emotional stress levels, while one quarter reported high (20) or very high (5) emotional stress levels.

4.1.10 <u>Ballet experience</u>

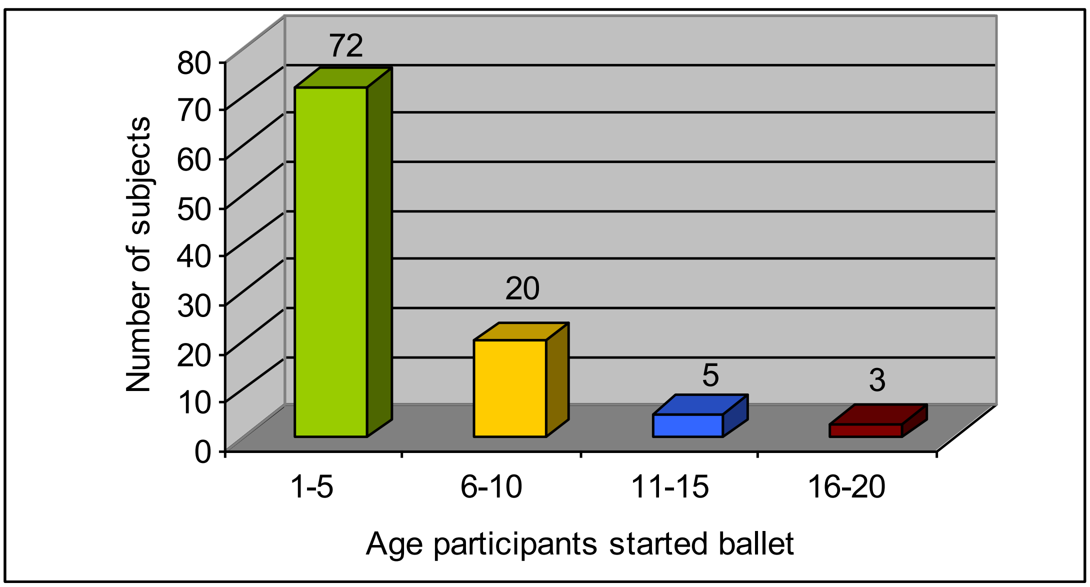

Fig 4.9 Age distribution for the commencement of ballet in the sample population (N=100)

The youngest age for starting ballet was 1 year old and the oldest was 20 years old. Seventy two percent of subjects reported starting ballet before the age of 6. The mean age for starting ballet was 5.28 years of age.

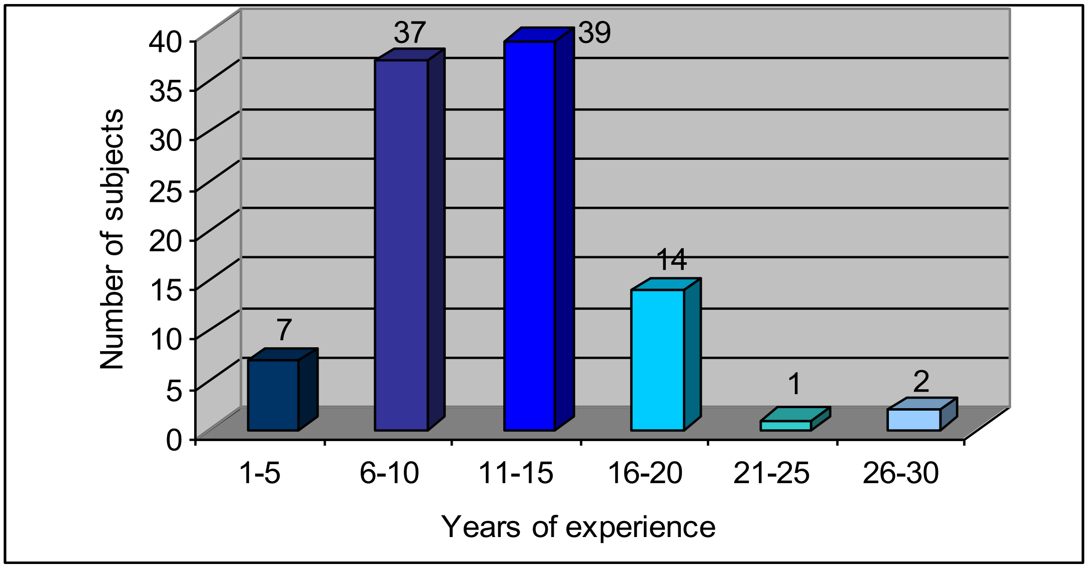

Fig 4.10 Years of ballet experience in the sample population (N=100)

The ballet dancer with the least experience had only 3 years experience, while the ballet dancer with the most experience had 29 years experience. The vast majority of subjects (76) had between 6 and 15 years experience. The mean for years of experience in ballet was 11. 55 years.

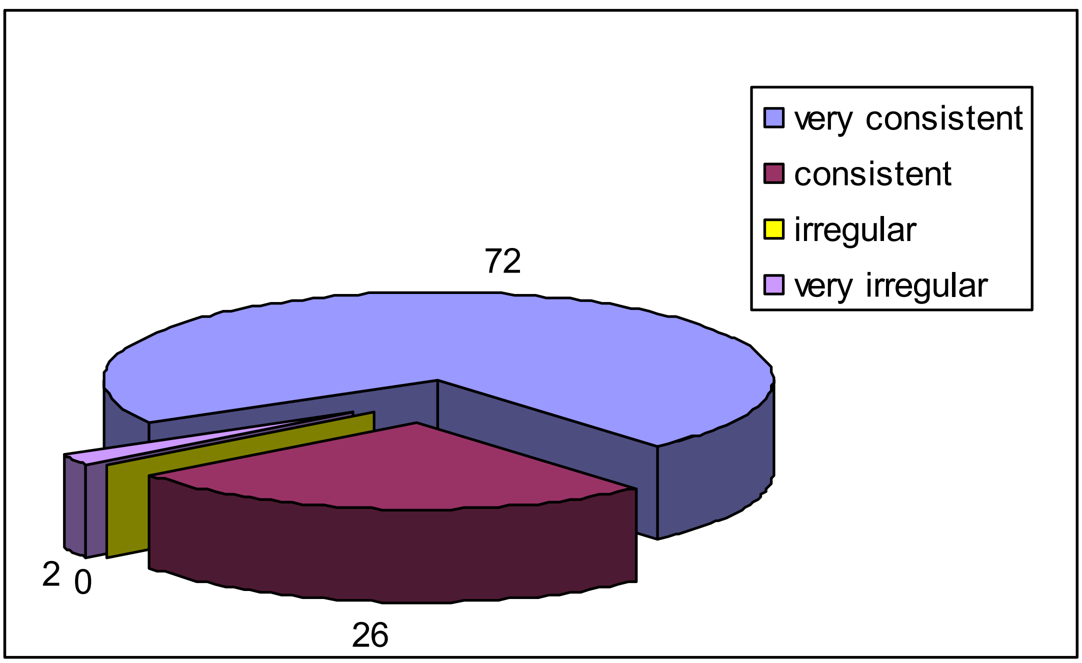

Fig 4.11 Consistency of ballet dancing in the sample population (N=100)

Since starting ballet, 98 subjects reported dancing either very consistently (72) or consistently (26).

4.1.11 Ballet training load

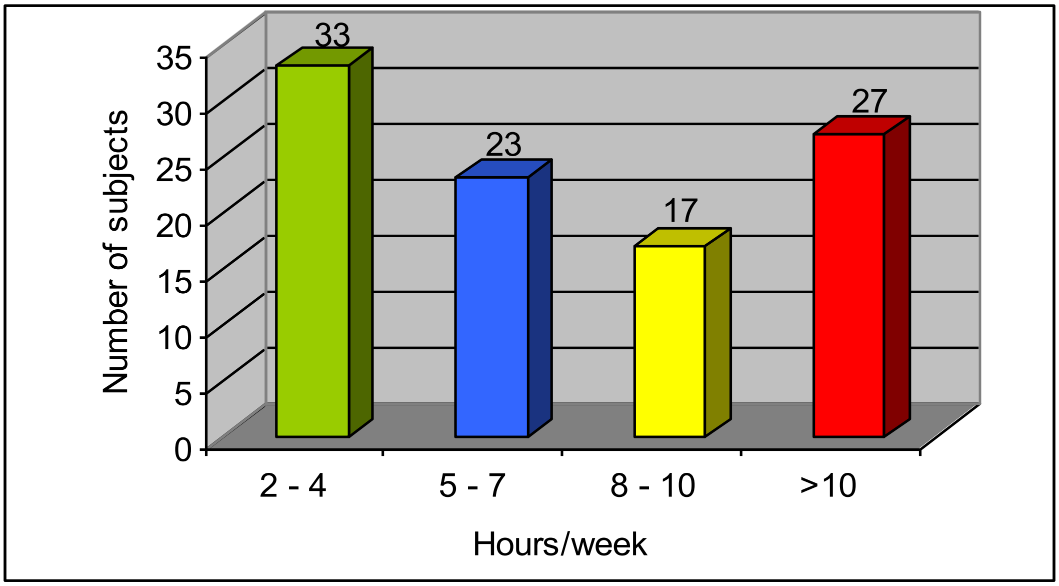

Fig 4.12 Hours of training per week in the sample population (N=100)

One third of subjects (33) danced 2-4 hours per week, 27 danced for greater than 10 hours per week, 23 for 5-7 hours and 17 for 8-10 hours. The mean for hours of training is 2.62 (i.e. between 7 and 8 hours).

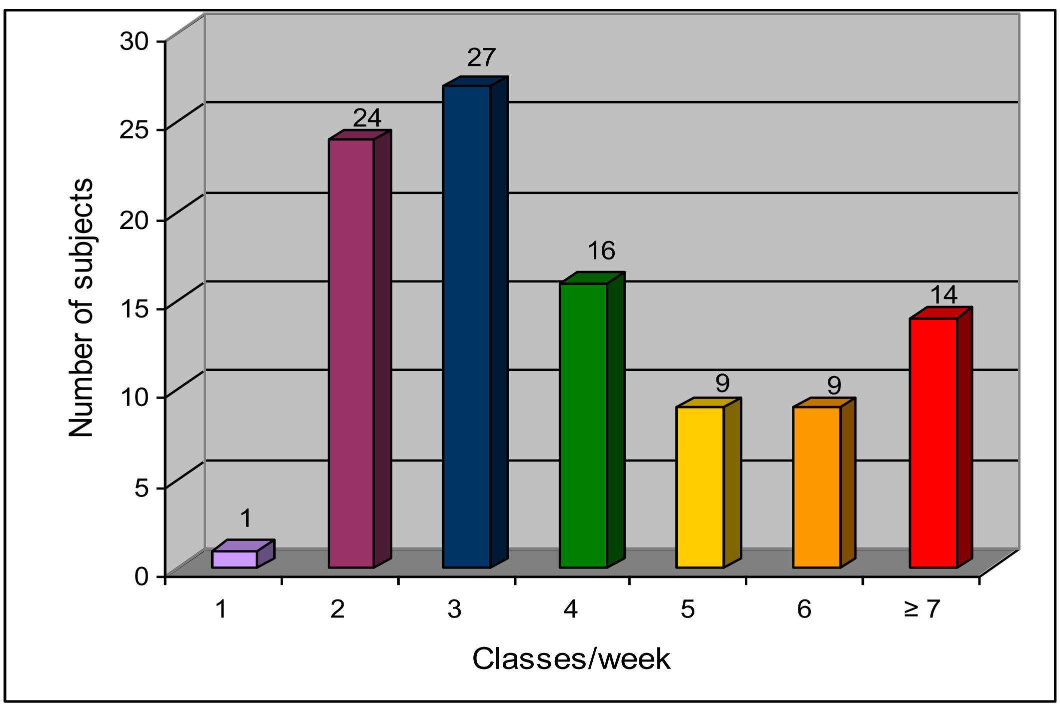

Fig 4.13 Ballet classes per week in the sample population (N=100)

Most (67) of the subjects danced 2 to 4 classes per week and 14 reported attending at least 7 classes per week.

4.2 LIFETIME INCIDENCE OF BALLET INJURIES

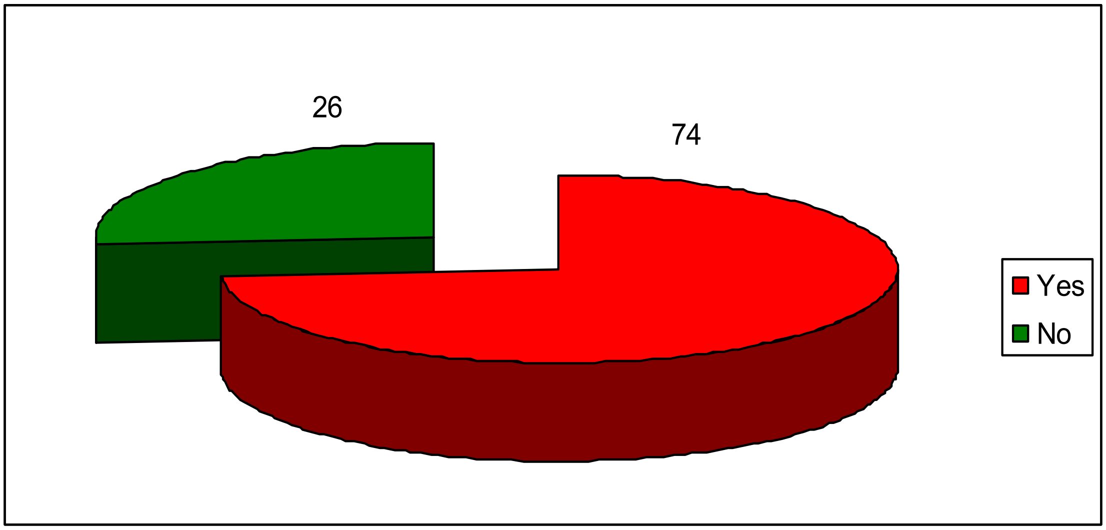

Fig. 4.14 Lifetime incidence of ballet injuries in the sample population (N=100)

The lifetime incidence of ballet injuries in the sample population was 74%.

4.3 PREVALENCE OF BALLET INJURIES

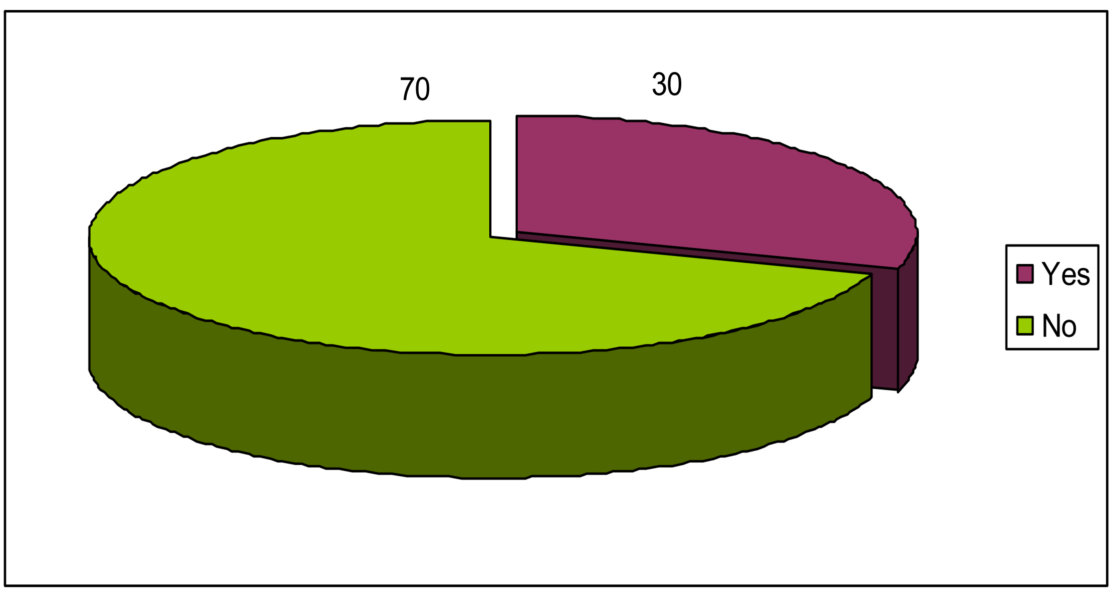

Fig 4.15 Prevalence of ballet injuries in the sample population (N=100)

The prevalence of ballet injuries in the sample population was 30%.

4.4 FREQUENCY OF INJURIES

Table 4.1 Frequency of injuries in the lifetime incidence group (n=74)

Frequency of injuries	Number of subjects
1/month	2 (2.7%)
1/3 months	10 (13.5%)
1/6 months	12 (16.2%)
1/12 months	50 (67.6%)
Total	74 (100%)

The majority (67.6%) of ballet dancers, who had sustained previous injury, reported sustaining 1 injury per year. Very few (2.7%) subjects reported sustaining an injury as often as once per month.

4.5 SEVERITY OF INJURIES

4.5.1 Severity rating (Lifetime incidence)

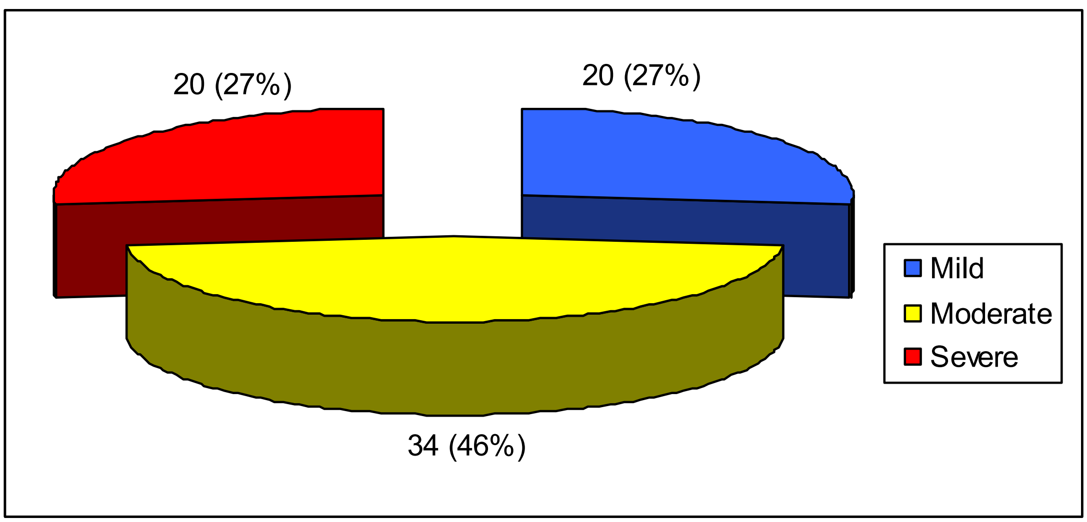

Fig. 4.16 Severity of worst injury in the lifetime incidence group (n=74)

With reference to the most severe ballet injury ever sustained; 34 (46%) said that their worst injury had been moderate. The remainder rated their worst injury as mild (27%) or severe (27%).

4.5.2 Severity rating (Prevalence)

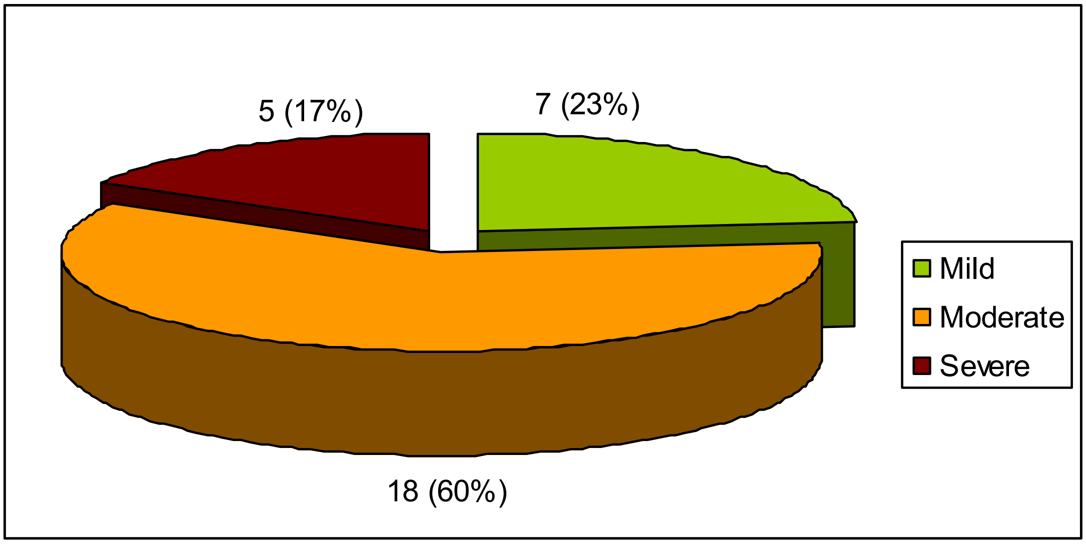

Fig. 4.17 Severity of present injury in the prevalence group (n= 30)

Most (60%) of the subjects, presently suffering from a dance injury, rated their injury as moderate; while 17% rated their present injury as severe.

4.5.3 Affect on dancing (Lifetime Incidence)

4.5.3.1 Disability due to injury in lifetime incidence group

Thirty five (47%) dancers from the lifetime incidence group (n=74) reported that at least one injury ever sustained had prevented dancing.

4.5.3.2 Affect of injury on dancing by location

Table 4.2 Affect of injuries on dancing by location (lifetime incidence) (n=74)

Location of injury	A Prevented dancing	B Limited dancing	A+B Affected dancing	No effect
Foot and toes	10	23	33	24
Ankle	12	17	29	21
Achilles	0	14	14	9
Leg	1	12	13	8
Knee	9	18	27	14
Hamstrings	2	13	15	10
Quadriceps	0	8	8	7
Hip/ Groin	3	22	25	13
Low back	7	25	32	14
Other	2	5	7	4

Table 4.2 represents whether an injury to a location had affected (limited or prevented) dancing. Injuries to the foot and toes (33), lower back (32), ankle (29), knee (27) and hip/groin (25) were most often responsible for limiting or preventing dancing.

4.5.4 Affect on dancing (Prevalence)

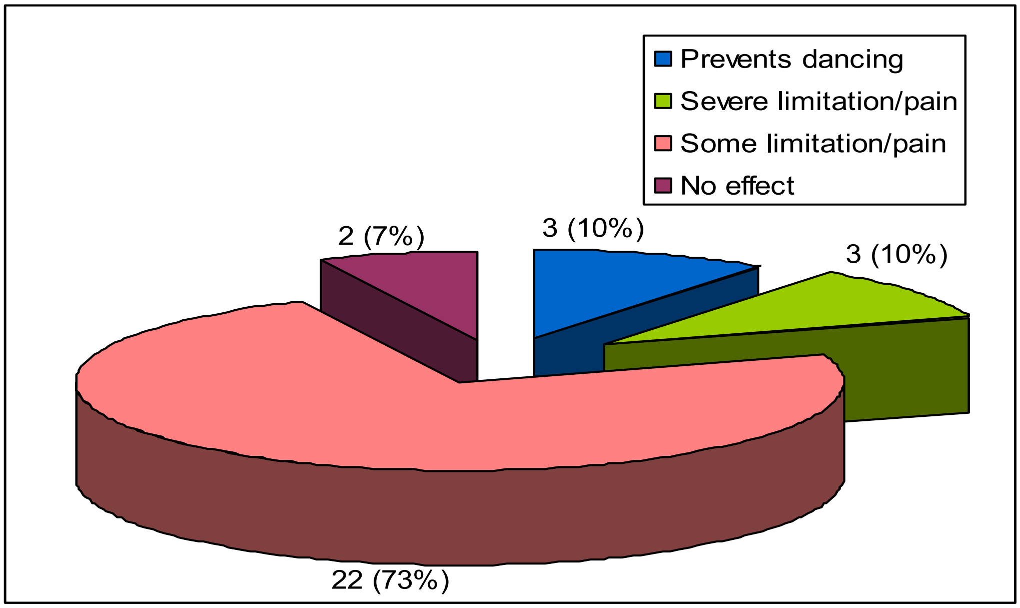

Fig 4.18 Affect of injury on dancing in the prevalence group (n=30)

The majority of the dancers (73%) reported that their present injury caused some limitation or pain, while 10% reported that their injury had prevented dancing. Only 2% said that their present injury had no effect on their dancing.

4.5.5 Period of disability

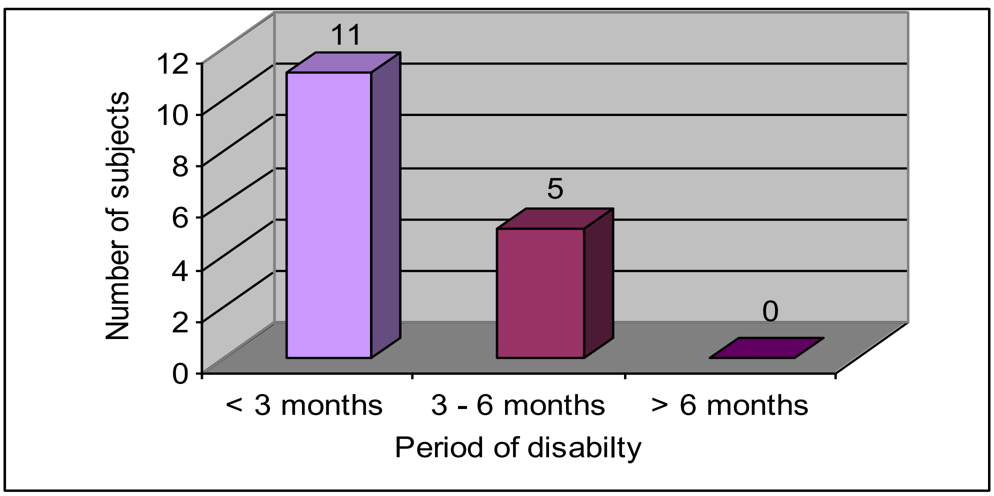

Fig 4.19 Period of disability in the prevalence group (n=30)

Sixteen subjects (53%) in the prevalence group reported that their present injury had at some stage prevented dancing. Eleven dancers were unable to dance for a period of less than 3 months, while 5 could not dance for a period of 3 to 6 months.

4.5.6 <u>Duration of present injury</u>

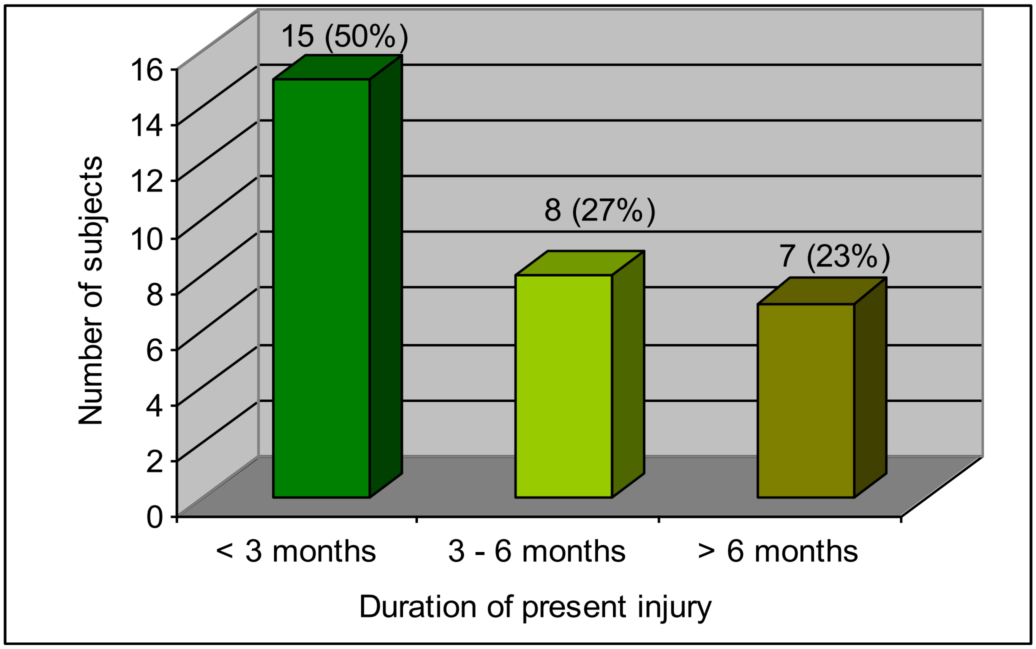

Fig 4.20 Duration of present injury (n=30)

Half (15) of the injured dancers had been injured for a period of less than 3 months. Twenty seven percent (8) had been injured for 3 to 6 months and 23% (7) for a period longer than 6 months.

4.6 LOCATION OF INJURIES

4.6.1 Location of injuries (Lifetime Incidence)

Table 4.3 Location of injuries in lifetime incidence group (n=74)

Location of injury	A Very often	B Often	C Seldom	A + B + C Injuries per location	Never
Foot and toes	8	20	29	57	43
Ankle	4	13	33	50	50
Achilles	0	6	17	23	77
Leg	2	8	11	21	79
Knee	4	12	25	41	59
Hamstrings	1	9	15	25	75
Quadriceps	0	1	14	15	85
Hip/ Groin	1	14	23	38	62
Low back	7	19	20	46	54
Other	1	2	8	11	89

Table 4.3 represents the frequency with which injuries to the specific locations were reported by subjects in the lifetime incidence group. The most commonly reported injured areas were the foot and toes (57), ankle (50) and lower back (46). A history of injuries to the knee (41) and the hip/groin (38) were also commonly reported. Other locations of injury were reported by 11 subjects and these consisted of the neck (4), upper back (3), wrist (2), the intercostal muscles (1) and the coccyx (1).

Table 4.4 Location of worst injury in lifetime incidence group (n=74)

Location	Total
Foot/toes	19 (26%)
Ankle	16 (22%)
Knee	15 (20%)
Lower back	8 (11%)
Hip/groin	7 (9%)
Hamstring	2 (3%)
Achilles	2 (3%)
Coccyx	2 (3%)
Intercostal muscles	1 (1%)
Neck	1 (1%)
Upper Back	1 (1%)
Total	74 (100%)

Table 4.4 represents the locations of the worst injury ever suffered. The foot/toes (26%), ankle (22%) and knee (20%) were most frequently affected

4.6.2 <u>Location of injury (Prevalence)</u>

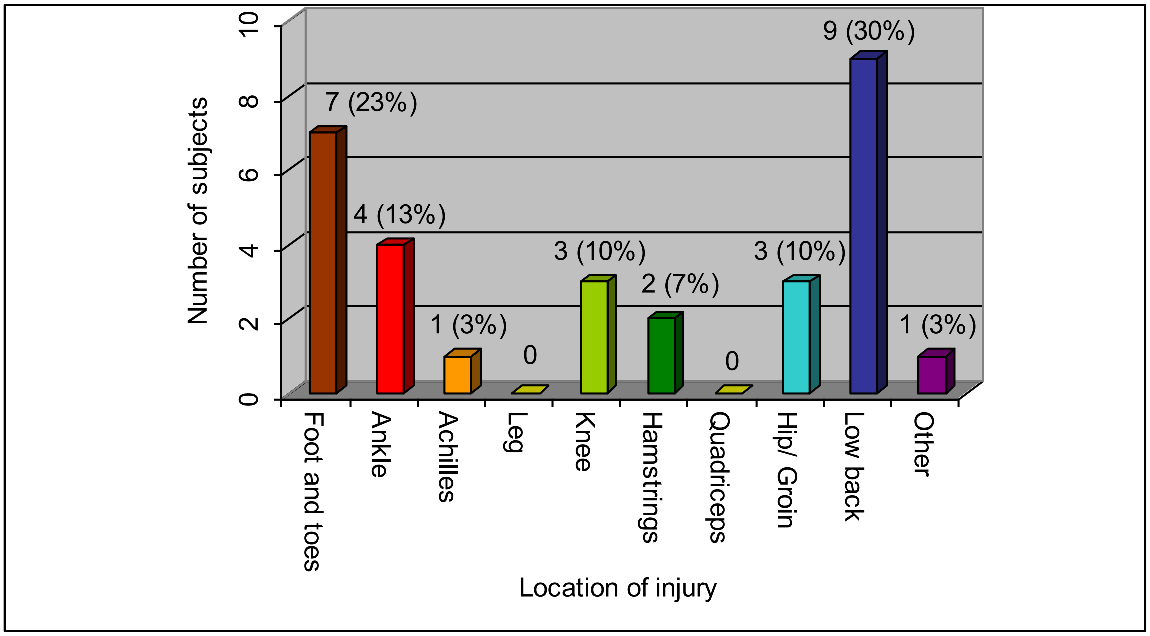

Fig 4.21 Location of present injury (n=30)

Injuries to the lower back (30%) and foot and toes (23%) were reported most commonly.

4.7 PRECIPITATING FACTORS FOR INJURY

4.7.1 Cause of injury

Table 4.5 Cause of present injury (n=30)

Insufficient rest / overwork	10
Incorrect posture / placement	10
Jumping	8
Repetitive movements	8
Insufficient warm-up / cold	7
Twisting	7
Pointe work	7
Falling	6
Unsuitable floors	4
Difficult choreography	3
Other	3
Stretching	1
Partnerships	0

Table 4.5 represents the frequency with which certain factors were reported to be possible causes of injury. Subjects could indicate more than one factor. Incorrect posture/placement (10) and insufficient rest/overwork (10) were reported most often. Jumping and repetitive movements were each mentioned by 8 dancers, followed by insufficient warm-up (7), twisting (7) and pointe work (7).

4.7.2 Class-specific causes

Table 4.6 Class-specific causes of present injury (n=30)

Part of class attributed to injury	Total
Unsure	13
Allegro	7
Pointe work	6
Barre	5
Adage	4
Warm-up	3
Centre	2
Pirrouettes	1

Table 4.6 represents the part of class to which subjects in the prevalence group attributed the onset of their present injury. Subjects could indicate more than one option. The majority of the dancers (43%) were unable to attribute any part of class to the onset of their injury. Seven reported that their injury occurred during allegro and 6 during pointe work.

4.8 TREATMENT

4.8.1 Level of care-seeking

4.8.1.1 Level of care-seeking (Lifetime Incidence)

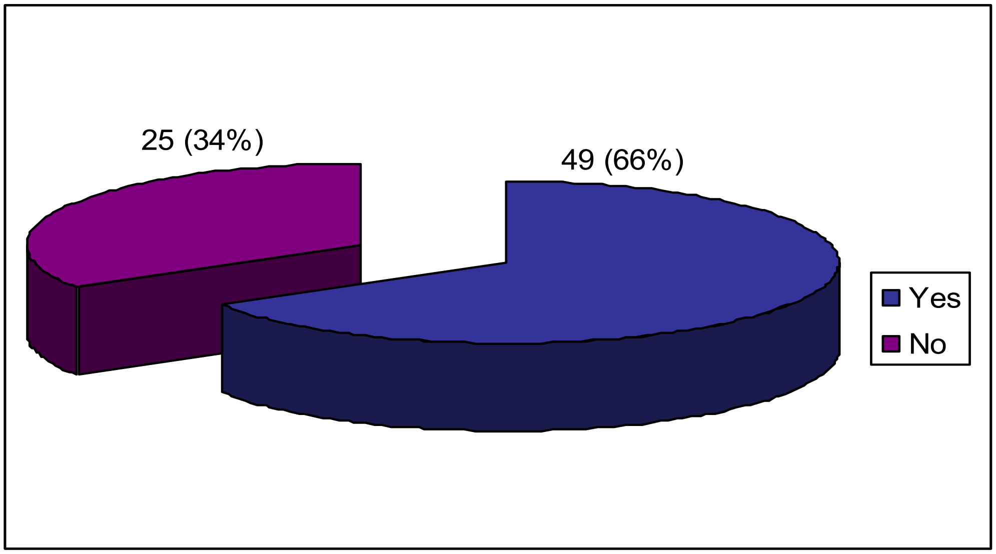

Fig 4.22 Level of care seeking in lifetime incidence group (n=74)

A large proportion (66%) of dancers in the lifetime incidence group had at some stage sought treatment for their injuries.

4.8.1.2 Level of care-seeking (Prevalence)

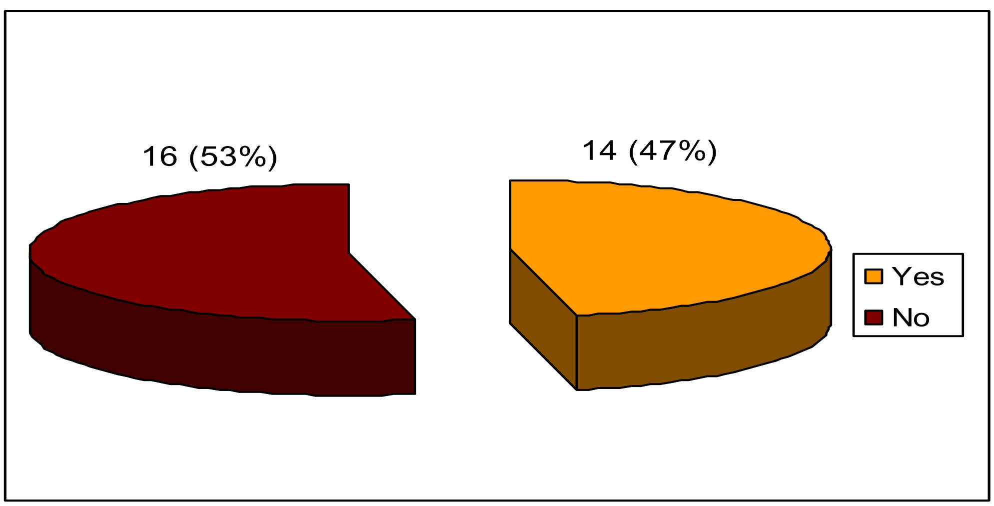

Fig 4.23 Level of care seeking in the prevalence group (n=30)

Of the dancers who were presently suffering from an injury, 14 (47%) had sought treatment for their injury.

4.8.2 Type of treatment

4.8.2.1 Type of treatment (Lifetime Incidence)

Table 4.7 Type of treatment received by the incidence group (n=49)

Physiotherapy	40 (82%)
Bracing / Strapping	22 (45%)
Chiropractic	18 (37%)
Medication / Injections	18 (37%)
Rehabilitation	9 (18%)
Other	8 (16%)
Orthopaedic	5 (10%)

Table 4.7 represents the type of treatment received by subjects in the lifetime incidence group. Some subjects reported receiving more than one type of treatment. Physiotherapy was the most common source of treatment, used by 82% of the subjects. The second most common treatment used was bracing/ strapping (45%), followed by chiropractic (37%) and medication/injections (37%).

4.8.2.2 Type of treatment (Prevalence)

Table 4.8 Treatments used for present injury (n=14)

Physiotherapy	10 (71%)
Bracing / Strapping	8 (57%)
Chiropractic	8 (57%)
Medication / Injections	6 (43%)
Rehabilitation	4 (29%)
Orthopaedic	0
Other	0

In the prevalence group the majority of subjects (71%) consulted a physiotherapist, 57% received bracing/strapping and 57% consulted a chiropractor. Medication/injections were received by 43%. Some dancers had sought more than one form of treatment for their present injury.

4.8.3 Compliance with treatment

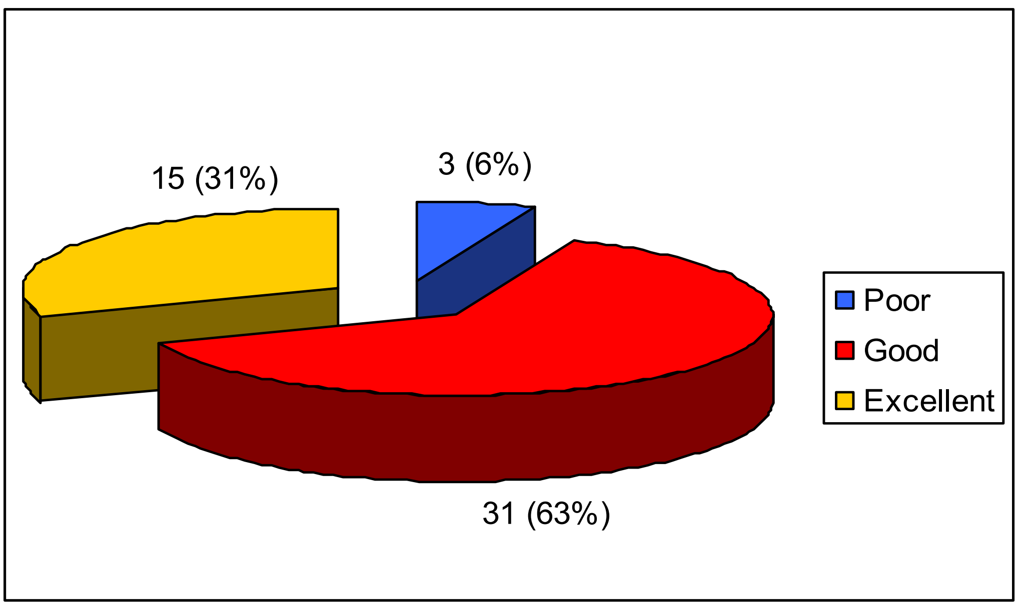

Fig 4.24 Treatment compliance (n=49)

The majority (63%) of dancers who had ever sought treatment reported that their compliance was good, 31% reported an excellent compliance and 6% reported that they complied poorly.

4.8.4 Severity of injury

Table 4.9 Severity of injury and frequency of care seeking (n=30)

Injury severity	Treatment received		Total
	Yes	No	
Severe	0 (0%)	0 (0%)	0
Moderate	12 (52%)	11 (48%)	23
Mild	2 (29%)	5 (71%)	7
Total	14	16	30

The majority (52%) of dancers, who had described the severity of their injury as moderate, sought treatment for their present injury. Only 29% of the dancers who described their injury as mild sought treatment for their injury.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	70.910[a]	2	.000	.000		
Likelihood Ratio	76.497	2	.000	.000		
Fisher's Exact Test	72.081			.000		
Linear-by-Linear Association	65.736[b]	1	.000	.000	.000	.000
N of Valid Cases	100					

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.22.

b. The standardized statistic is 8.108.

The p value (0.000) from Fisher's Exact Test is less than 0.05. H_0 is rejected and therefore there is sufficient evidence to suggest that the two variables chosen are dependent.

4.9 INDIVIDUAL/RISK FACTORS ASSOCIATED WITH BALLET INJURIES

4.9.1 Gender

4.9.1.2 Gender and Lifetime Incidence of Injury

Table 4.10 Gender and Lifetime Incidence of Injury (n=74)

	Gender		Total
	Female	Male	
Injured	69 (73%)	5 (100%)	74
Not Injured	29 (27%)	0 (0%)	26
Total	95	5	100

The lifetime incidence of injury was 100% in males and 73% in females.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.849[b]	1	.174		
Continuity Correction[a]	.700	1	.403		
Likelihood Ratio	3.102	1	.078		
Fisher's Exact Test				.323	.214
Linear-by-Linear Association	1.831	1	.176		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.30.

The p value (0.403) from Yates' Continuity Correction is greater than 0.05, therefore H_0 is not rejected and there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.1.2 Gender and prevalence of injury

Table 4.11 Gender and prevalence of injury (n=30)

	Gender		Total
	Female	Male	
Injured	26 (27%)	4 (80%)	30
Not Injured	69 (73%)	1 (20%)	70
Total	95	5	100

The prevalence of injury was 80% in males and 27% in females.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.266[b]	1	.012		
Continuity Correction[a]	4.010	1	.045		
Likelihood Ratio	5.660	1	.017		
Fisher's Exact Test				.027	.027
Linear-by-Linear Association	6.203	1	.013		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.50.

The p value (0.045) from Yates' Continuity Correction is less than 0.05, therefore H_0 is rejected and there is sufficient evidence to suggest that the two variables chosen are dependent.

4.9.2 Ethnicity

4.9.2.1 Ethnicity and lifetime incidence

Table 4.12 Ethnicity and lifetime incidence (n=74)

	Ethnic Group				Total
	Black	White	Coloured	Asian	
Injured	2 (100%)	67 (73%)	3 (75%)	2 (100%)	74
Not injured	0 (0%)	25 (27%)	1 (25%)	0 (0%)	26
Total	2	92	4	2	100

Although the lifetime incidence among black and asian subjects was 100% the very small numbers of subjects in these ethnic groups makes it impossible to draw any significant conclusions.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	1.473[a]	3	.688	.751		
Likelihood Ratio	2.476	3	.480	.719		
Fisher's Exact Test	.889			1.000		
Linear-by-Linear Association	.118[b]	1	.731	.787	.512	.232
N of Valid Cases	100					

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .52.

b. The standardized statistic is -.344.

As the p value (1) from Fisher's Exact Test is greater than 0.05, H_0 is not rejected and there is therefore not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.2.2 Ethnicity and prevalence

Table 4.13 Ethnicity and prevalence (n=30)

	Ethnic Group				Total
	Black	White	Coloured	Asian	
Injured	2 (100%)	26 (28%)	2 (50%)	0 (0%)	74
Not injured	0 (0%)	66 (72%)	2 (50%)	2 (100%)	26
Total	2	92	4	2	100

Once again the unbalanced distribution of subjects makes drawing any significant conclusions regarding the association between ethnicity and the prevalence of injuries difficult.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	6.418[a]	3	.093	.088		
Likelihood Ratio	7.074	3	.070	.088		
Fisher's Exact Test	5.397			.106		
Linear-by-Linear Association	1.120[b]	1	.290	.400	.237	.159
N of Valid Cases	100					

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .60.

b. The standardized statistic is 1.058.

As the p value (0.106) from Fisher's Exact Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.3 Age

4.9.3.1 Age and lifetime incidence

Results of Independent T-Test (Appendix K)

From Levene's Test the p value (0.001) is less than 0.05, therefore H_0 is rejected and there is sufficient evidence to suggest that the population variances are significantly different. The p value is therefore applied to the non-equality of variances. Since this p value (0.000) is less than 0.05 it can be concluded that sufficient evidence exists to reject H_0 and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.3.2 Age and prevalence

Results of Independent T-Test (Appendix K)

Since the p value (0.2) on Levene's Test is greater than 0.05, H_0 is not rejected and hence there is sufficient evidence to suggest that the population variances are not significantly different. The p value is therefore applied to the equality of variances. This p value (0.097) is greater than 0.05, therefore there does not exist sufficient evidence to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.4 **Height**

4.9.4.1 **Height and lifetime incidence**

Results of Independent T-Test (Appendix K)

On Levene's test, as the p value (0.266) is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value was then applied to the equality of variances. This p value (0.114) is also greater than 0.05. It is thus concluded that there does not exist sufficient evidence to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.4.2 **Height and Prevalence**

Results of Independent T-Test (Appendix K)

Since, on Levene's Test, the p value (0.665) is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value was therefore applied to the equality of variances. Since this p value (0.036) is less than 0.05 sufficient evidence does exist to reject H_0 and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.5 Weight

4.9.5.1 Weight and lifetime incidence

Results of Independent T-Test (Appendix K)

Since on Levene's Test, the p value (0.694) is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value was therefore applied to the equality of variances and this p value (0.012) is less than 0.05, concluding that sufficient evidence to reject H_0 does exist and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.5.2 Weight and prevalence

Results of Independent T-Test (Appendix K)

The p value on Levene's Test is 0.571, which is greater than 0.05. Therefore H_0 is not rejected and there is not sufficient evidence to suggest that the population variances are significantly different. The p value is therefore applied to the equality of variances. Since this p value (0.016) is less than 0.05 sufficient evidence exists to reject H_0 and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.6 Body Mass Index

4.9.6.1 Body Mass Index and lifetime incidence

Results of Independent T-Test (Appendix K)

Since, on Levene's Test the p value (0.636) is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value is therefore applied to the equality of variances. Since this p value (0.1) is greater than 0.05 it concludes that there does not exist sufficient evidence does not exist to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.6.2 Body Mass Index and prevalence

Results of Independent T-Test (Appendix K)

On Levene's Test p value (0.141) is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value is then applied to the equality of variances. The p value (0.372) is greater than 0.05, so it is concluded that there does not exist sufficient evidence to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.7 Ballet experience

4.9.7.1 Age of onset of ballet

4.9.7.1.1 Age of onset of ballet and lifetime incidence

Results of Independent T-Test (Appendix K)

The p value (0.039) on Levene's Test is less than 0.05. Thus H_0 is rejected and hence there is sufficient evidence to suggest that the population variances are significantly different. We therefore apply the p value to the non-equality of variances. Since this p value (0.05) is equal to 0.05, there is not sufficient evidence to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.7.1.2 Age of onset of ballet and prevalence

Results of Independent T-Test (Appendix K)

On Levene's Test the p value (0.001) is less than 0.05, H_0 is rejected and hence there is sufficient evidence to suggest that the population variances are significantly different. When the p value is applied to the non-equality of variances, the p value (0.041) is less than 0.05 and it is concluded that there does exist sufficient evidence to reject H_0 and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.7.2 <u>Years of ballet experience</u>

4.9.7.2.1 <u>Years of ballet experience and lifetime incidence</u>

<u>Results of Independent T-Test</u> (Appendix K)

Since the p value (0.015) on Levene's Test is less than 0.05, H_0 is rejected and there is sufficient evidence to suggest that the population variances are significantly different. The p value is therefore applied to the non-equality of variances. Since this p value (0.00) is less than 0.05 sufficient evidence exists to reject H_0 and hence there is sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.7.2.2 <u>Years of ballet experience and prevalence</u>

<u>Results of Independent T-Test</u> (Appendix K)

The p value (0.555) on Levene's Test is greater than 0.05, H_0 is not rejected and hence there is not sufficient evidence to suggest that the population variances are significantly different. The p value was then applied to the equality of variances. Since this p value (0.750) is greater than 0.05, sufficient evidence does not exist to reject H_0 and hence there is not sufficient evidence to suggest that the population means from both variables are significantly different.

4.9.7.3 Consistency of dancing

4.9.7.3.1 Consistency of dancing and lifetime incidence

Table 4.14 Consistency of dancing and lifetime incidence (n=74)

	Consistency of dancing		Total
	Very consistently / consistently	Very irregularly	
Injured	51 (71%)	23 (82%)	74
Not injured	21 (29%)	5 (18%)	26
Total	72	28	100

The incidence of injury was greatest (82%) in the subjects who danced very irregularly.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.340[b]	1	.247		
Continuity Correction[a]	.817	1	.366		
Likelihood Ratio	1.411	1	.235		
Fisher's Exact Test				.315	.184
Linear-by-Linear Association	1.327	1	.249		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.28.

As the p value (0.247) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.7.3.2 <u>Consistency of dancing and prevalence</u>

Table 4.15 Consistency of dancing and prevalence (n=30)

	Consistency of dancing		Total
	Very consistently / consistently	Very irregularly	
Injured	24 (33%)	6 (21%)	30
Not injured	48 (67%)	22 (79%)	70
Total	72	28	100

The prevalence of injury was greatest (33%) in the subjects who danced very consistently or consistently.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.361[b]	1	.243		
Continuity Correction[a]	.853	1	.356		
Likelihood Ratio	1.418	1	.234		
Fisher's Exact Test				.332	.179
Linear-by-Linear Association	1.347	1	.246		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.40.

As the p value (0.243) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.7.4 Level of training

4.9.7.4.1 Level of training and lifetime incidence

Table 4.16 Level of training and lifetime incidence (n=74)

	Level of training		Total
	Student	Professional/Teacher	
Injured	63 (71%)	11 (100%)	74
Not injured	26 (29%)	0 (0%)	26
Total	89	11	100

The lifetime incidence of injury was 100% in professional dancers and teachers, and 71% in student dancers.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.343[b]	1	.037		
Continuity Correction[a]	2.957	1	.086		
Likelihood Ratio	7.090	1	.008		
Fisher's Exact Test				.062	.030
Linear-by-Linear Association	4.299	1	.038		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.86.

The p value (0.086) from Yates' Continuity Correction is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependant.

4.9.7.4.2 Level of training and prevalence

Table 4.17 Level of training and prevalence (n=30)

	Level of training		Total
	Student	Professional/Teacher	
Injured	25 (28%)	5 (45%)	30
Not injured	64 (72%)	6 (55%)	70
Total	89	11	100

The prevalence of injury was higher among professional dancers and teachers (45%) than students (28%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.406[b]	1	.236		
Continuity Correction[a]	.700	1	.403		
Likelihood Ratio	1.318	1	.251		
Fisher's Exact Test				.298	.198
Linear-by-Linear Association	1.392	1	.238		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.30.

The p value (0.236) from Pearson Chi-Square Test is greater than 0.05. Therefore H_0 is not rejected and there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.8 Ballet training load

4.9.8.1 Hours danced per week

4.9.8.1.1 Hours danced per week and lifetime incidence

Table 4.18 Hours danced per week and lifetime incidence (n=74)

	Hours danced per week		Total
	> 8 Hours	< 8 Hours	
Injured	39 (89%)	35 (62.5%)	74
Not injured	5 (11%)	21 (37.5%)	26
Total	44	56	100

The lifetime incidence of injuries among subjects who danced more than 8 hours per week (89%) was 26.5% higher than in the group who danced less than 8 hours per week (62.5%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.748[b]	1	.003		
Continuity Correction[a]	7.443	1	.006		
Likelihood Ratio	9.360	1	.002		
Fisher's Exact Test				.005	.003
Linear-by-Linear Association	8.661	1	.003		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.44.

As the p value (0.003) from the Pearson-Chi Square Test is less than 0.05, H_0 is rejected. It is concluded that there is sufficient evidence to suggest that the two variables chosen are dependent.

4.9.8.1.2 Hours danced per week and prevalence

Table 4.19 Hours danced per week and prevalence (n=30)

	Hours danced per week		Total
	> 8 Hours	< 8 Hours	
Injured	22 (50%)	8 (14%)	30
Not injured	22 (50%)	48 (86%)	70
Total	44	56	100

The prevalence of injuries among subjects who danced more than 8 hours per week (50%) was 36% higher than in the group who danced less than 8 hours per week (14%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.966[b]	1	.000		
Continuity Correction[a]	13.314	1	.000		
Likelihood Ratio	15.243	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	14.816	1	.000		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.20.

As the p value (0.000) from the Pearson Chi-Square Test is less than 0.05, H_0 is rejected and therefore there is sufficient evidence to suggest that the two variables chosen are dependent.

4.9.8.2 Classes per week

4.9.8.2.1 Classes per week and lifetime incidence

Table 4.20 Classes per week and lifetime incidence (n=74)

	Classes/week				Total
	≤ 3	4	5	≥ 6	
Injured	30 (94%)	10 (62.5%)	18 (67%)	16 (64%)	74
Not Injured	2 (6%)	6 (37.5%)	9 (33%)	9 (36%)	26
Total	32	16	27	25	100

The lifetime incidence of injuries was greatest (94%) in the group who attended fewer than 4 classes per week.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	9.641[a]	3	.022	.022		
Likelihood Ratio	11.436	3	.010	.014		
Fisher's Exact Test	10.923			.011		
Linear-by-Linear Association	6.560[b]	1	.010	.012	.006	.003
N of Valid Cases	100					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.16.

b. The standardized statistic is 2.561.

The p value (0.011) from Fisher's Exact Test is less than 0.05. H_0 is rejected and therefore there is sufficient evidence to suggest that the two variables chosen are dependent.

4.9.8.2.2 Classes per week and prevalence

Table 4.21 Classes per week and prevalence (n=30)

	Classes/week				Total
	≤ 3	4	5	≥ 6	
Injured	13 (41%)	3 (19%)	5 (19%)	9 (36%)	30
Not Injured	19 (59%)	13 (81%)	22 (81%)	16 (64%)	70
Total	32	16	27	25	100

The prevalence of injuries was highest in subjects who attended fewer than 4 classes per week (41%), followed by subjects who danced more than 6 classes per week (36%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.808[a]	3	.186	.190		
Likelihood Ratio	4.955	3	.175	.187		
Fisher's Exact Test	4.659			.193		
Linear-by-Linear Association	.416[b]	1	.519	.582	.291	.060
N of Valid Cases	100					

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 4.80.

b. The standardized statistic is .645.

The p value (0.193) from Fisher's Exact Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.9 Diet

4.9.9.1 Diet and lifetime incidence

Table 4.22 Diet and lifetime incidence (n=74)

	Dietary Habits			Total
	Poor/Adequate	Good	Excellent	
Injured	18 (90%)	46 (68%)	10 (83%)	74
Not injured	2 (10%)	22 (32%)	2 (17%)	26
Total	20	68	12	100

The incidence of injury was greatest in the groups who described their dietary habits as poor / adequate (90%) or excellent (83%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	4.631[a]	2	.099	.118		
Likelihood Ratio	5.182	2	.075	.087		
Fisher's Exact Test	4.396			.111		
Linear-by-Linear Association	.710[b]	1	.399	.424	.261	.114
N of Valid Cases	100					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 3.12.

b. The standardized statistic is .843.

The p value (0.111) from Fisher's Exact Test is greater than 0.05, H_0 is not rejected. There is therefore not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.9.2 Diet and prevalence

Table 4.23 Diet and prevalence (n=30)

	Dietary Habits			Total
	Poor/Adequate	Good	Excellent	
Injured	5 (25%)	20 (29%)	5 (42%)	30
Not injured	15 (75%)	48 (71%)	7(58%)	70
Total	20	68	12	100

The incidence of injury was greatest (42%) in the subjects who described their dietary habits as excellent.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	2.349[a]	2	.309	.337		
Likelihood Ratio	2.667	2	.263	.293		
Fisher's Exact Test	2.274			.337		
Linear-by-Linear Association	1.088[b]	1	.297	.385	.192	.081
N of Valid Cases	100					

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.50.

b. The standardized statistic is 1.043.

The p value (0.337) from Fisher's Exact Test is greater than 0.05. H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.10 Emotional stress level

4.9.10.1 Emotional stress level and lifetime incidence

Table 4.24 Emotional stress level and lifetime incidence (n=74)

	Emotional stress levels			Total
	> Average	Average	< Average	
Injured	20 (80%)	44 (73%)	10 (67%)	74
Not injured	5 (20%)	16 (27%)	5 (33%)	26
Total	25	60	15	100

Subjects with above average emotional stress levels (80%) had a greater lifetime incidence of injury than the subjects with average (73%) or below average (67%) emotional stress levels.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.901[a]	2	.637
Likelihood Ratio	.906	2	.636
Linear-by-Linear Association	.892	1	.345
N of Valid Cases	100		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 3.90.

As the p value (0.637) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.10.2 Emotional stress level and prevalence

Table 4.25 Emotional stress level and prevalence (n=30)

	Emotional stress levels			Total
	> Average	Average	< Average	
Injured	8 (32%)	20 (33%)	2 (13%)	30
Not injured	17 (68%)	40 (67%)	13 (87%)	70
Total	25	60	15	100

The lifetime incidence of injury was higher in subjects who reported having average (33%) or above average (32%) emotional stress levels.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.349[a]	2	.309
Likelihood Ratio	2.667	2	.263
Linear-by-Linear Association	1.088	1	.297
N of Valid Cases	100		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.50.

As the p value (0.309) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

4.9.11 Relationship between incidence of ballet injury and weakness in dancing posture

4.9.11.1 Weakness in dance posture and lifetime incidence

Table 4.26 Weakness in dance posture and lifetime incidence (n=74)

	Postural weakness	No postural weakness	Total
Injured	50 (81%)	24 (63%)	74
Not injured	12 (19%)	14 (37%)	26
Total	62	38	100

The lifetime incidence of injuries was 18% higher in subjects who had a weakness in their dancing posture pointed out to them (81%), than in subjects who reported no postural weakness (63%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.745[b]	1	.053		
Continuity Correction[a]	2.891	1	.089		
Likelihood Ratio	3.670	1	.055		
Fisher's Exact Test				.063	.046
Linear-by-Linear Association	3.707	1	.054		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.88.

As the p value (0.053) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent at the 5% level of significance, although the results would be significant at a 6% significance level.

4.9.10.2 Weakness in dance posture and prevalence

Table 4.27 Weakness in dance posture and prevalence (n=30)

	Postural weakness	No postural weakness	Total
Injured	21 (34%)	9 (23%)	30
Not injured	41 (66%)	29 (76%)	70
Total	62	38	100

The prevalence of dance injuries was 11% higher in subjects who had a postural weakness pointed out to them (34%) than in the group who reported no apparent postural weakness (23%).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.164[b]	1	.281		
Continuity Correction[a]	.730	1	.393		
Likelihood Ratio	1.188	1	.276		
Fisher's Exact Test				.370	.197
Linear-by-Linear Association	1.153	1	.283		
N of Valid Cases	100				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.40.

As the p value (0.281) from the Pearson Chi-Square Test is greater than 0.05, H_0 is not rejected and therefore there is not sufficient evidence to suggest that the two variables chosen are dependent.

CHAPTER 5

DISCUSSION OF THE RESULTS

5.1 THE DEMOGRAPHIC DATA

5.1.1 Sample selection

Convenience sampling was used to select the group of 100 ballet dancers, aged 10 to 50 years, from ballet studios as well as the only professional ballet company in the greater Durban area. No attempt was made to stratify the sample by gender, age, ethnic group, height, weight, or any other demographic characteristic.

5.1.2 Gender distribution (Figure 4.1)

Ninety five percent of subjects in the sample population were female and only 5% male. Studies by Bowling (1989:731), Credico and Davis (1999:44), Quirk (1983:508) and Weisler et al. (1996:754) similarly included a majority of females. The small number of males however, makes it difficult to draw any significant conclusions regarding the relative lifetime incidence and prevalence of injuries between males and females.

5.1.3 Ethnic distribution (Figure 4.2)

The ethnic distribution was very unbalanced in this investigation with only 2 black, 2 asain and 4 coloured subjects. The remainder (92) of the subjects were white. This makes it impossible to draw any strong conclusions regarding the association between ethnicity and ballet injuries. Although Gelabert (1986:187) suggested that genetic factors could predispose black dancers to injuries, a review of the literature did not reveal any studies which had investigated the association between ethnicity and ballet injuries.

5.1.4 **Age distribution** (Figure 4.3)

The inclusion criteria of this study allowed for an age distribution of 10 to 50 years. This was based on the age ranges of other epidemiological studies on ballet injuries (Bowling, 1989:731/2; Credico and Davis, 1999:44; Micheli et al., 1984:204; Reid, 1987:231 and Weisler et al., 1996:754) as well as consultation with the chairlady of the Royal Academy of Dance, Durban (Clark, 2003). More than half (53%) of the subjects in this investigation were between the ages of 11 and 15, while 31% were aged 16 to 20 years. The age range varied from 11 to 35 years. The mean age was 16.82 years. This mean is similar to that of Reid et al. (1987:349) and Weisler (1996:755) whose mean ages were 15.4 and 17 respectively.

The mean age in this study was lower than in a number of other studies in which the mean age ranged from 22 to 30 years (Coplan, 2002:581; Credico and Davis, 1999:44; Hamilton and Hamilton, 1992:268 and Micheli et al., 1984:204). This may be attributed to the fact that that these studies included more professional dancers who are usually older.

5.1.5 **Height distribution** (Figure 4.4)

The shortest subject measured 120cm and the tallest 187cm. Half (50%) of the subjects measured 160 to 169cm and 26% measured 150 to 159cm. The mean height was 162.01cm, which is similar to Benson et al. (1989:61), Coplan (2002:581) and Micheli et al. (1984:204) who reported mean heights of 166cm, 163cm (females) and 164cm respectively.

5.1.6 **Weight distribution** (Figure 4.5)

The subjects' weights varied from 30 to 72kg with the majority (44%) of subjects weighing 50 to 59kg, followed by 39% weighing 40 to 49kg. The mean weight of the sample was 50.49kg, similar to the mean weights of 52kg, 53kg and 48kg (females) reported by Benson et al. (1989:61), Coplan (2002:581) and Micheli et al. (1984:204) respectively. As the sample was predominantly female (95%) this might account for the mean weight of the dancers being closer to the mean weight of female dancers in other studies, rather than the higher mean weight (77kg) of males as reported in Coplans' study (2002:581).

5.1.7 **Body Mass Index** (Figure 4.6)

The majority (67%) of subjects had a Body Mass Index (BMI) that was lower than the norm of 20 to 25 (Beers and Berkow, 1999:26), while 31% fell within the normal range. The BMI ranged from 13.57 – 27.52. The mean BMI was 19.2, which was very similar to the mean BMI of the sample populations (18.52 and 19.16) in studies by Bowling (1989:732) and Wiesler et al. (1996:755) respectively.

5.1.8 **Dietary habits** (Figure 4.7)

No specific criteria or definitions were applied to the description of dietary habits in this study, which relied on the subjects' choice of four options, based on their opinion of their diet. Good dietary habits were reported by the majority (68%) of subjects, adequate dietary habits by 18%, excellent by 12% and poor by 2%. The participants' responses to this question may not reflect the true nature of the quality of their diet, but merely their perception thereof. This may be particularly relevant to ballet dancers as they tend to have a distorted idea of their body image (Reid, 1988:305). The results differ from those of Benson et al. (1989:58), who by scientific means, found that 69% of the dancers in their study had a dietary intake of less than 70% of the Recommended Dietary Allowance (RDA) for key nutrients.

5.1.9 **Emotional stress levels** (Figure 4.8)

Sixty percent of the subjects in this study reported average emotional stress levels. One quarter reported that their emotional stress levels were above average (20% high and 5% very high), while below average emotional stress levels were reported by 15% (11% low and 4% very low).

This is contrary to the findings of Hamilton et al. (1999:266) who indicated that ballet dancers may have higher emotional stress levels than the general population as they often display an "over achiever" personality type. The difference might be ascribed to the fact that the subjects in the present study were subjectively reporting their perceptions of their emotional stress levels; while stress levels in the study by Hamilton et al. (1999:266) were obtained by more objective means.

5.1.10 **Ballet experience**

5.1.10.1 Age of onset (Figure 4.9)

The reported age of starting ballet ranged from 1 to 20 years of age. The mean age for starting ballet was 5.28 years. Although this is similar to the findings of Credico and Davis (1999:44), Hamilton and Hamilton (1992:273) and Reid (1987:232), whose means range from 6.7 to 7.6 years, these means are slightly higher, perhaps due to the larger proportion of males involved in the studies of Credico and Davis' (1999:44) and Hamilton and Hamilton (1992:273). Hamilton and Hamilton (1992:273) reported that the mean age of onset for males was 11.3 years.

Seventy two subjects (72%) had started ballet before the age of 6 and 20 (20%) had started ballet between the ages of 6 and 10. Only 8 started ballet after the age of 10. This concurs with the findings of Reid (1988:303) who stated that the majority of females begin ballet training between 4 and 8 years of age.

5.1.10.2 Years of experience (Figure 4.10)

The subjects reported between 3 and 29 years of experience. The mean for years of experience was 11.55 years. Means from other studies vary greatly, from 6 to 21 years of experience (Credico and Davis, 1999:44; Reid et al., 1987:347; Weisler et al., 1996:755); possibly due to differences in the nature of the sample populations (e.g. student vs. professional dancers).

The large proportion of dancers with more than 10 years of ballet experience (56%) is interesting given the relatively young population and may be attributed to the young age of onset of dancing.

5.1.10.3 Consistency of dancing (Figure 4.11)

No specific criteria were applied to the definition of the consistency of dancing, but the responses suggest that the majority (72%) of the sample had danced 'very consistently' since starting ballet. No other studies have commented on the consistency of dancing since the onset of ballet training.

5.1.11 Ballet training load

5.1.11.1 Hours per week (Figure 4.12)

To participate in this study subjects had to dance at least 2 hours per week. The mean number of hours danced per week was between 7 and 8 hours. This is a lot less than in the studies by Reid et al. (1987:34) and Reid (1987:232) in which the means were 18.2 hours and 14.7 hours respectively. This difference may be due to the fact that these studies involved dancers from more formal ballet schools and ballet companies, rather than local ballet studios as was predominantly the case in the present study.

5.1.11.2 Classes per week (Figure 4.13)

Fifty two percent of the dancers from the sample danced less than 4 classes per week, however literature suggests that ballet dancers frequently dance more than one class a day, five days a week (Malone et al., 1990:355). This difference may be due to the non-professional nature of the majority of the sample in the present study. Fourteen percent of the sample did, however dance at least seven classes per week.

5.2 LIFETIME INCIDENCE (Figure 4.14)

The lifetime incidence of ballet injuries among the sample of ballet dancers was 74%.

Literature suggests that the lifetime incidence of ballet injuries varies according to whether dancers are professionals or students. The lifetime incidence of injuries among professional dancers ranges from 50 to 100% (Coplan, 2002:579; Hamilton et al., 1989:263/4; Russell, 1994:12; Sohl and Bowling, 1990:318) while the lifetime incidence among students ranges from 47 to 63% (Coplan, 2002:579,583; Reid, 1987:232).

Considering the high proportion of students in the present study the lifetime incidence of ballet injuries seems relatively high.

5.3 PREVALENCE (Figure 4.15)

The prevalence of ballet injuries among the sample was 30%. This concurs with the findings of Bowling (1989:731), Coplan (2002:579) and Garrick and Requa (1993:587) who reported prevalence rates of 17 to 42%.

5.4 **FREQUENCY OF INJURY** (Table 4.1)

Although the lifetime incidence of injuries is high, the frequency of injury in the lifetime incidence group is generally low, with 67.6% suffering only one injury per year. Only 2.7% reported sustaining injuries as often as once per month.

5.5 **SEVERITY OF INJURY** (Figure 4.16 and Figure 4.17)

No specific criteria were applied to the definition of severity of injury in the present study unlike in Bowlings' study (1989:732) that rated the severity of an injury according to its diagnosis. In the present study moderate injuries were reported most commonly in both the incidence group (46%) and the prevalence group (60%), followed by mild injury (27% incidence and 23% prevalence) and then severe injury (27% incidence group and 17% in the prevalence group). This differs from Bowlings' study on the prevalence of injuries which found that mild injury (tissue injuries including sprains and strains) occurred most frequently (60%), followed by severe injury (28%) that included fractures, dislocations, cartilage and vertebral injuries. Moderate injury (bad bruising, swelling or inflammation of muscles) was reported by 12%.

5.6 **AFFECT ON DANCING**

5.6.1 **Affect on dancing in the lifetime incidence group**

Thirty five (47%) subjects in the lifetime incidence group had suffered an injury in their lifetime that had prevented dancing. This is similar to the study performed at Ballet West that found that 62% of dancers suffered temporary or permanent disability due to an injury (www.alexandertechniquedance.net, 2002) and Credico and Davis' study (1999:45) where 71% of subjects reported an interruption in dancing. The results of the present study thus provide further evidence that a significant proportion of ballet dancers, at some stage in their 'career', suffer an injury that is severe enough to prevent them dancing for a period of time.

5.6.2 <u>Affect on dancing in the prevalence group</u>

Ninety eight percent of subjects from the prevalence group reported that their injury had either caused some limitation/pain, severe limitation/pain or prevented dancing (Figure 4.18). This suggests that ballet injuries are almost always, at some stage, severe enough to affect the ballet dancers' ability to dance. This figure is higher than reported by Sohl and Bowling (1990:318), who found that 84% of a sample of professional dancers in the United Kingdom stated that their dancing had been affected by their injury.

5.6.3 <u>Period of disability</u> (Figure 4.19)

No ballet dancer in this study had suffered an injury which had permanently affected their ability to dance, however subjects who could no longer dance were not accounted for due to the recruitment process of dancers from local dance studios and the inclusion criteria of this study.

Most of the subjects whose ability to dance was affected were unable to dance for a period of less than 3 months. These results tend to agree with those of Credico and Davis (1999:45) and Reid (1987:232/3), suggesting that ballet injuries generally do not cause long-term disability.

5.7 <u>DURATION OF PRESENT INJURY</u> (Figure 4.20)

Most of the subjects in the prevalence group (77%) reported that they had been injured for less than 6 months. This suggests that acute and sub-acute injuries are more prevalent than chronic injuries in the sample population. This differs from Hamilton (1988:158) who stated that acute injuries are less common than overuse syndromes in ballet dancers.

5.8 LOCATION OF INJURY

The results indicate that injuries to the lower limb were reported most commonly, followed by injuries to the spine and then the upper limb, which is consistent with the findings of Garrick and Requa (1993:587/8), Milan (1994:121) and Reid (1987: 232).

The most frequently injured areas in the lifetime incidence group were the foot/toes, ankle, lower back, knee and the hip/groin (Table 4.3).

The most common injuries from the prevalence group (Figure 4. 21) occurred in the lower back (30%), foot and toes (23%), ankle (13%), knee (10%), hip/groin (10%), hamstring (7%), achilles (3%) and other (3%).

These findings are supported by Bowling (1989:732), Garrick and Requa (1993:587/589) and Reid (1987:232) and provides further evidence that the most commonly injured areas in ballet dancers are the foot/toes, ankle, lower back and knee.

The reported locations of the worst injury ever sustained (Table 4.4) and the most common locations of injury that caused limitation or prevention of dancing (Table 4.2) agree with the findings above.

Milan (1994:127) reported that upper limb injuries were rare, with the wrist being the most commonly affected area. This concurs with the findings of the present study (Table 4.3).

5.9 **PRECIPITATING FACTORS FOR INJURY**

5.9.1 **Cause of present injury** (Table 4.5)

In the present study the most commonly reported causes for injury (in order of frequency) were insufficient rest/overwork, followed by incorrect posture/placement, jumping, repetitive movement, insufficient warm-up/cold, twisting, pointe work, falling, unsuitable floors, difficult choreography, other and stretching. Partnerships were not mentioned as a cause of injury. This was similar to the results of Bowlings' study (1989:730) where overwork was reported as the most common cause, followed by unsuitable flooring, insufficient warm-up, difficult choreography, repetition of difficult movements and other causes such as an inadequate diet, falling and turnout.

Rist and Kennedy (1986:1) divided dance injuries into 2 categories, 'overuse' injuries and 'traumatic' injuries. According to Quirk (1994:123) traumatic injuries occur rarely. The majority of injuries in the present study were non-traumatic, which concurs with Quirks findings.

5.9.2 **Class-specific causes of injury** (Table 4.6)

Bowling (1989:732) reported that 16% of injuries occurred during ballet class. On a review of the literature no studies were found where the ballet class was broken down to find the part of class during which injuries most commonly occur.

Most (13) of the subjects involved in the present study were unable to attribute the onset of their injury to a specific part of their class. Seven reported that their injury occurred in allegro, 6 during pointe work, 5 at the barre, 4 during adage, 3 in their warm up, 2 during centre practice and 1 in pirouettes. The fact that most injuries occur during allegro and pointe work is understandable because it is during these parts of class that the greatest stress is placed on the body (Clark, 2003).

5.10 TREATMENT

5.10.1 **Level of care seeking** (Figure 4.22 and 4.23)

Two thirds of the subjects in the incidence group had at some stage sought treatment for a ballet injury (Figure 4.22). Of the subjects in the prevalence group, 47% had sought treatment for their present injury (Figure 4.23). This suggests that a significant proportion of injuries are severe enough to cause the dancer to seek treatment.

These figures are however much lower than the level of care seeking reported in other studies, which ranges from 81 to 100% (Bowling, 1989:733, Credico and Davis, 1999:45/6 and Reid, 1987:232/3), perhaps due to the predominance of nonprofessional dancers in the sample.

5.10.2 **Type of treatment** (Table 4.7 and 4.8)

The most common treatment received by the injured subjects was physiotherapy (82% lifetime incidence, 71% prevalence), bracing/strapping (45% lifetime incidence, 57% prevalence), chiropractic (37% lifetime incidence, 57% prevalence), medication/injections (37% lifetime incidence, 43% prevalence), rehabilitation (18% lifetime incidence, 29% prevalence), other (16% lifetime incidence, 0% prevalence), and orthopaedic (10% lifetime incidence, 0% prevalence).

These results are similar to Bowling (1989:733) who found that 76% of the subjects consulted a physiotherapist and less than half a medically qualified practitioner, while they differed from Credico and Davis (1999:45/6) who reported the most frequently sought treatment to be rehabilitation, followed by orthopaedic and then physiotherapy.

It appears that many dancers receive a number of different forms of treatment but by far the most common is physiotherapy.

5.10.3 **Treatment compliance** (Figure 4.24)

Sixty seven percent of the dancers who had ever sought treatment for an injury reported that their compliance to treatment was good, 31% reported excellent and 6% poor. It is possible that this good compliance may at least in part contribute to the quickest possible recovery from injury, and the low proportion of chronic injuries is this sample may be related to this factor.

5.10.4 **Association between severity of injury and frequency of care seeking** (Table 4.9)

Results of the Chi-Square Test revealed a significant association (p=0.000) between the severity of injury and the frequency of care seeking in the prevalence group. This suggests that the more severe an injury, the more likely the subject is to receive treatment, which concurs with Reid (1987:232/3) who implied that treatment was only sought by dancers who considered their injuries to be serious.

5.11 INDIVIDUAL/ RISK FACTORS ASSOCIATED WITH BALLET INJURIES

5.11.1 **Gender** (Table 4.10 and Table 4.11)

Although the lifetime incidence of ballet injuries among males was 100% and only 73% in females, results of the Chi-Square Test (p=0.403) suggested there was no association between gender and lifetime incidence of injury. The small number of males in the sample (n=5), makes reaching any conclusions regarding the association between these factors unlikely.

Results of the Chi-Square Test (p=0.045) suggest that gender is associated with the prevalence of ballet injury, suggesting that male ballet dancers are more likely to be presently suffering from an injury. However, the small number of males (n=5) in the sample casts some doubt on this conclusion.

5.11.2 **Ethnicity** (Table 4.12 and Table 4.13)

Results of the Chi-Square Tests revealed no significant association between lifetime incidence (p=1.000) or prevalence (p=0.106) of injuries and ethnicity. Although this suggests ethnic group is not a risk factor this conclusion should not be drawn since 92% of the sample was white.

5.11.3 **Age** (Appendix K)

It seems to indicate from the sample data that the dancers who have suffered from a ballet injury have a higher mean age (17.73 years) when compared to the mean age of dancers who have never been injured (14.23). The results of the Independent T-Test (p=0.000) indicated that these means were significantly different, which suggests that older dancers are more likely to have suffered a ballet injury at some stage.

The results of the Independent T-Test (p=0.097) indicated no significant association between age and the prevalence of injury.

These results suggest that although older dancers are more likely to have sustained an injury in their ‘career’, they are not more likely to be injured at present, which is consistent with the findings of Hamilton (1988:148) and Hamilton et al. (1989:265).

5.11.4 **Height** (Appendix K)

The results of the Independent T-Test (p=0.014) indicated no significant association between height and the lifetime incidence of injury.

The Independent T-Test (p=0.039) indicated that the mean height of injured dancers (164.87cm) is significantly more than the mean height of uninjured dancers (160.79cm) in the prevalence group, suggesting that taller dancers are more likely to suffer from ballet injuries. This is supported by Gelabert (1986:184/5) who reported that certain body types, such as dancers with “longer spines”, are more prone to injury.

5.11.5 **Weight** (Appendix K)

Results from the Independent T-Test show that the mean weights of injured dancers in both the lifetime incidence (p=0.012) and prevalence (p=0.016) groups are significantly higher than the mean weights of uninjured dancers. This suggests that lighter dancers are less likely to sustain a ballet injury. Evidence in the literature, however suggests that dieting and inadequate food intake could be associated with an increased risk of injury (Hamilton, 1998:155; Hunter, 1994:27).

5.11.6 **<u>Body Mass Index</u>** (Appendix K)

The results of the Independent T-Tests indicated no significant association between Body Mass Index and the lifetime incidence (p=0.1) or prevalence (p=0.372) of injury.

Although the results of the present study (Figure 4.6) concur with suggestions in the literature (Bowling, 1989:732), that a large proportion of ballet dancers have a lower than normal BMI, it appears that a lower BMI is not associated with an increased risk of sustaining a ballet injury.

5.11.7 **<u>Ballet experience</u>**

5.11.7.1 <u>Age of onset of ballet</u> (Appendix K)

The results of the Independent T-Test (p=0.041) revealed that there is an association between the age of onset of ballet and the prevalence of injury. The mean age of onset of ballet in the injured dancers (6.53 years) was higher than the mean age in uninjured dancers (4.63years) suggesting that dancers who began ballet at a later age are more likely to be injured. This correlates with Rist and Kennedy (1986:52) who reported that starting ballet at a younger age may be associated with a decreased risk of injury development, perhaps due to the increased elasticity of ligaments when gently stretched at an early age.

5.11.7.2 <u>Years of ballet experience</u> (Appendix K)

The Independent T-Test revealed the mean years of ballet experience in injured dancers (12.33 years) in the lifetime incidence group was significantly higher (p=0.00) than the mean among uninjured dancers (9.35years). This suggests that the risk of having sustained an injury increases with increasing years of ballet experience.

There was however no significant association (p=0.750) between years of ballet experience and the prevalence of ballet injuries. This suggests that the prevalence of injuries is not cumulative with years of ballet experience i.e. less experienced dancers are just as likely as more experienced dancers to sustain a ballet injury at any given time.

5.11.7.3 Consistency of dancing (Table 4.14, Table 4.15)

Results of the Chi-Square Test did not reveal a significant association between the lifetime incidence (p=0.247) and prevalence (p=0.243) of injuries and the consistency of dancing. This suggests that the consistency of dancing i.e. dancing either very consistently, consistently or very irregularly, is not a risk factor for sustaining an injury.

5.11.7.4 Level of training (Table 4.16, Table 4.17)

Results of the Chi-Square Test did not reveal a significant association between the lifetime incidence (p=0.086) and prevalence of injuries (p=0.236) and the level of training of the dancers. These results differ from Hamilton (1998:148) who suggested that a higher level of training (i.e. professional dancers) was more of a risk factor for developing an injury than age. The differences in findings may be attributed to the predominance of young nonprofessional dancers in this study.

5.11.8 **Ballet training load**

5.11.8.1 Hours danced per week (Table 4.18, Table 4.19)

Results of the Chi-Square Test revealed a significant association between the lifetime incidence (p=0.003) and prevalence (p=0.000) of injuries and the number of hours danced per week. The lifetime incidence (89%) and prevalence (50%) of injuries was a lot higher in the group who danced more than 8 hours per week and also a lot higher than the total lifetime incidence (74%) and prevalence (30%) of the sample population. This suggests that dancers who dance more than 8 hours per week are more at risk of sustaining an injury, supporting the notion that dancers who are overworked and fatigued are more likely to be injured (Sohl and Bowling, 1990:318).

5.11.8.2 Classes per week (Table 4.20, Table 4.21)

Results of the Chi-Square Test revealed a significant association between the lifetime incidence (p=0.011) and the number of classes danced per week. The lifetime incidence (94%) of injuries was a lot higher in the group who danced less than 4 classes per week and also a lot higher than the total lifetime incidence (74%) of the sample population. This suggests that dancers who dance less than 4 classes per week are more at risk of sustaining an injury than those who dance more than 4 classes per week, perhaps due to the fact that these dancers may be less disciplined and technically weaker than those who dance more classes.

Results of the Chi-Square Test did not reveal a significant association between the prevalence (p=0.193) of injuries and the number of classes danced per week. These results suggest that although dancers who dance less than 4 classes a week are more likely to have sustained an injury in their ‘career’, they are not more likely to be injured at present.

5.11.9 **Diet** (Table 4.21, Table 4.22)

Results of the Chi-Square Test did not reveal a significant association between the lifetime incidence (p=0.111) and prevalence (p=0.337) of injuries and dietary habits. Although this suggests that dietary habits are not a risk factor for sustaining an injury it is not consistent with the findings of Benson et al. (1989:59), Hamilton (1998:155) and Hunter (1994:27) who found that poor dietary habits, such as inadequate food intake, dieting and weight fluctuations, were associated with an increase risk of injury. In the present study subjects were asked to rate their dietary habits as “poor”, “average”, “good” or “excellent”. This subjective questioning technique may not have produced results which accurately reflect the actual nature of the dietary habits of the sample. More objective criteria, such as used by Benson et al. (1989:59), would produce a more accurate indication of the association between diet and injuries.

5.11.10 **Emotional stress levels** (Table 24, Table 25)

Results of the Chi-Square Test did not reveal a significant association between the lifetime incidence (p=0.637) and prevalence (p=0.309) of injuries and emotional stress levels. This suggests that there is not a significant association between emotional stress and ballet injury. Hamilton et al. (1989:266) however reported that psychological stress, typically associated with certain personality types, may be associated with an increased risk of injury.

5.11.11 **<u>Weakness in dance posture</u>** (Table 26, Table 27)

Sixty two subjects reported having a weakness in their dancing posture pointed out to them. The most common reported weaknesses included an “arched back” (10), dancing with their “weight back” (7), “incorrect placement and stance” (6), “poor turn-out” (6) and “upper back weakness” (6).

Both the lifetime incidence and prevalence of ballet injury were higher in the group who reported a postural weakness. However, results of the Chi-Square Test did not reveal a significant association between the lifetime incidence ($p=0.053$) and prevalence ($p=0.281$) of injuries and a weakness in dance posture, suggesting that a weakness in dance posture is not a risk factor for the development of a ballet injury.

Although the association between these two factors is not statistically significant the results of the present study tend to support the findings of Hamilton (1986:61), Howse (2000:74) and Rist and Kennedy (1986:1); who reported that bad habits, awkward physique and weakness may be problematic and lead to the development of injuries.

The self-reporting nature of the present study may have led to an underestimation of the prevalence of dance posture weakness i.e. dancers may have been unaware of postural weaknesses and thus not reported on them.

5.12 LIMITATIONS OF THE STUDY

The subjects completed the questionnaires themselves (although under the supervision of the researcher), this was problematic for two reasons. Firstly it may have resulted in the reporting of inaccurate information when subjects did not fully understand the requirements of the question. Secondly most of the subjects were under 18 years of age and prior to completing the questionnaire had to obtain parental consent, this resulted in poor compliance. Collecting the data by means of interviews may alleviate these problems.

The convenience sampling method used resulted in a sample that was unstratified in terms of age, gender and ethnic group; making drawing conclusions from the statistical analysis difficult regarding these demographic characteristics. This sample, consisting predominantly of white females, may however represent the demographic nature of the population of ballet dancers in the area of study. Using stratified random sampling would however probably result in a more representative sample.

The questionnaire was designed to cover a broad number of issues related to ballet injuries. To properly investigate certain factors, more questions regarding a particular factor and more objectively defined options, could have produced more definitive conclusions.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The demographic composition of the sample provided some interesting information, which is generally in keeping with studies conducted in other countries (Bowling, 1989:731/2; Credico and Davis, 1999:44 Coplan, 2002:581; Hamilton and Hamilton, 1992:268 Micheli et al., 1984:204; Reid, 1987:231; Weisler et al., 1996:754), and may be representative of the general population of ballet dancers in the greater Durban area. The vast majority of ballet dancers are female and it appears that there are still very few non-white ballet dancers. The sample population was predominantly young (less than 20 years of age), but had a mean of 11.55 years experience possibly due to the fact that 72% started ballet before the age of 6. Significantly, it was found that most of the sample had a BMI lower than the normal range, which concurs with the general perception that ballet dancers are typically pre-occupied with their diet, and often underweight (Benson et al., 1989:58; Hunter, 1994:27; Reid,1988:305). The ballet training load of the sample population appeared relatively high, especially considering the mean age (16.82 years) of the dancers with 77% dancing more than 5 hours per week.

The lifetime incidence of ballet injuries was high (74%), but in keeping with trends from studies conducted in other countries. The prevalence of ballet injuries was 30%, suggesting that a significant proportion of ballet dancers in the area of study are injured at any given time.

Most injuries were reported to be moderate in severity. However, the results suggest that injuries significantly affect a large proportion of those who are injured. Nearly half of the dancers who had sustained an injury, reported that at least one injury had prevented them dancing at some stage in their ‘career’, while 98% of the prevalence group reported at least some limitation/pain due to their present injury. The duration of injuries as well as the period of disability tended to be of short duration.

In keeping with previous studies the most common locations of injuries were the foot/toes, ankle, lower back and knee (Bowling, 1989:732; Garrick and Requa, 1993:587/589; Reid 1987:232).

The most commonly reported precipitating factors were insufficient rest/overwork, incorrect posture/placement, jumping, repetitive movement, insufficient warm-up/cold, twisting, pointe work and falling. Most dancers were unable to attribute the onset of their injury to a specific part of their class but allegro and pointe work emerged as areas for concern.

The level of care seeking was high in both the lifetime incidence (66%) and prevalence (47%) groups, with the most common sources of treatment being physiotherapy, bracing/strapping, chiropractic and medication/injections. The positive relationship between the severity of injury and the frequency of care seeking was found to be statistically significant.

The unbalanced distribution of the sample in respect to gender and ethnicity made it impossible to draw any strong conclusions regarding the association between these two factors and ballet injuries. It could be argued that the results of the study are mainly representative of white female ballet dancers in the area of study.

Older ballet dancers were more likely to have sustained an injury at some stage. Increasing weight was identified as a risk factor in both the lifetime incidence and prevalence group while tallness was associated with an increased prevalence of injury. The results suggest that BMI, diet and emotional stress are not risk factors for the development of ballet injuries.

A younger age of onset of ballet was associated with a decrease in prevalence of injury, while an increase in years' of ballet experience was associated with an increase in the lifetime incidence of injuries. The ballet dancers' level of training was found not to be associated with the development of injuries. With reference to training load, dancing more than 8 hours per week was significantly associated with the lifetime incidence and prevalence of injury. This suggests that a high training load predisposes dancers to injury.

The descriptive results suggest that dance posture weakness may be a risk factor for ballet injury, this association was not found to be statistically significant.

6.2 Recommendations

- The sampling technique used in this study was convenience sampling which may have introduced bias into the sampling process, resulting in weak external validity. It is recommended that a stratified random sampling technique be used.

- It is often difficult for dancers to determine if their injury occurred in ballet or a different dance discipline. It is recommended that a study is conducted that either incorporates all dance disciplines or includes only subjects who exclusively dance ballet.

- A more detailed study into the association between diet and menstrual history, and ballet injury is recommended.

- It is recommended that the association between pes planus and pes cavus and ballet injuries be investigated. This would require objective clinical assessment of the dancers' feet.

- It is recommended that the association between the type of floor most commonly danced on and the prevalence of ballet injuries be investigated.

- It is recommended that the duration, quality and nature of warm-up and warm down be assessed in order to determine any association with the prevalence of ballet injuries.

- It is recommended that future research studies specifically investigate ballet injuries in males as well as in professional dancers.

- If factors such as dietary habits, emotional stress levels, consistency of dancing and treatment compliance are to be investigated, it is recommended that more specific and/or objective evaluation criteria are applied.

- It is recommended that the questionnaire be completed by the researcher i.e. interview. This would facilitate collection of the most accurate data.

- With reference to statistical analysis, it is recommended that Logistic Regression Analysis be considered and applied where appropriate, in similar epidemiological studies.

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APPENDIX A

Questions to be asked before commencing the questionnaire (either telephonic or face-to-face):

Inclusion Criteria:

Are you between the ages of 10 and 50?
Are you a ballet dancer?
Do you have at least 2 years of ballet dancing experience?
Do you dance more than 2 hours per week?

APPENDIX B

Informed Consent

Date: 2003-02-22

Title of research project:	An epidemiological investigation of dance injuries in ballet dancers in the greater Durban area.
Name of supervisor:	Dr. C. Korporaal (031-2042611)
Name of Research Student:	Kate Balding (031-2042205)
Name of Institution:	Durban Institute of Technology

Please circle the appropriate answer

1. Have you read the patient information sheet? YES/NO
2. Have you had opportunity to ask questions regarding this study? YES/NO
3. Have you received satisfactory answers to your questions? YES/NO
4. Have you had an opportunity to discuss this study? YES/NO
5. Have you received enough information about this study? YES/NO
6. Who have you spoken to regarding this study? ________________________
7. Do you understand the implications of your involvement in this study? YES/NO
8. Do you understand that you are free to withdraw from this study? YES/NO
   a) at any time?
   b) Without having to give a reason for withdrawing?
   c) Without affecting your future health care?
9. Do you agree to voluntarily participate in this study? YES/NO

IF YOU HAVE ANSWERED NO TO ANY OF THE ABOVE, PLEASE OBTAIN THE NECESSARY INFORMATION FROM THE RESEARCHER AND / OR SUPERVISOR BEFORE SIGNING. THANK YOU.

PLEASE PRINT IN BLOCK LETTERS

SUBJECTS NAME_____________________SIGNATURE__________________

WITNESS' NAME ____________________SIGNATURE___________________

RESEARCHERS' NAME ______________SIGNATURE___________________

GUARDIAN'S / PARENT'S NAME_________________
SIGNATURE___________________

APPENDIX C
LETTER OF INFORMATION

Dear Participant,

Welcome to my study. Thank you for your interest.
The title of my research project is:
An epidemiological investigation of dance injuries in ballet dancers in the greater Durban area.

Name of supervisor:	Dr. C. Korporaal	(031-2042611)
Name of Research Student:	Kate Balding	(031-2042205)
Name of Institution:	Durban Institute of Technology	

The purpose of the study:
This study will involve research on 100 ballet dancers to determine the epidemiology of ballet injuries in the greater Durban area.

Procedures:
You will be required to complete a questionnaire about dance injuries, where and how they occur. The average time for ballet dancers to complete the questionnaire will be 15 – 30 minutes.

Benefits: Should you be suffering from any injuries during the course of your participation in this research, you are offered 2 optional free treatments at the Chiropractic Day Clinic at the Durban Institute of Technology. Also the results of this research will be forwarded to the Principals of the Ballet Schools for distribution to your teacher, to allow for improved recommendations with regard to your training.

Risks/ Discomforts and Cost:
There are no risks / discomfort or cost involved from your participation in the study.

Confidentiality:
All patient information is confidential and the results will be used for research purposes only. You have the right to be informed of any new findings that are made and you may ask questions of an independent source if you so wish. If you are not satisfied with any area of the study please feel free to contact the Durban Institute of Technology Research Ethics Committee.

Thank you for your participation,

Yours sincerely,

Kate Balding (Chiropractic Intern) **Dr. C. Korporaal** (Supervisor)

APPENDIX D

Letter of assent

Dear participant,

I am conducting research on injuries among ballet dancers in the greater Durban area. The purpose of this study is to investigate the frequency and nature of injuries among ballet dancers and to help identify potential risk factors.

This study will include 100 ballet dancers, from dance studios in the Durban area. If you agree to participate, you will be required to complete a questionnaire. All the information supplied by you will be treated confidentially and used for research purposes only.

Participation is voluntary and failure to participate will not result in any adverse consequences.

Please feel free to contact Kate Balding (researcher), or my supervisor,
Dr. Charmaine Korporaal if you have any questions.

Thank you very much

Yours sincerely,

Kate Balding
(Chiropractic Intern)
204 2205 (w) 563 4363 (h)
(h)

Dr. C. Korporaal
(Supervisor)
204 2611 (w) 083 2463562

I ________________________________ hereby agree to Participate in the above-mentioned study.

Signature: ______________________________ Date: ____________

Parent's Name __________________________

Signature: ______________________________ Date: ____________

APPENDIX E
Letter of consent.

Dear Principal,

This letter serves as a request to perform research at your ballet school.
The title of my research project is:
An epidemiological investigation of dance injuries in ballet dancers in the greater Durban area.

Name of supervisor:	Dr. C. Korporaal	(031-2042611)
Name of Research Student:	Kate Balding	(031-2042205)
Name of Institution:	Durban Institute of Technology	

The purpose of the study:
This study will involve research on 100 ballet dancers to determine the epidemiology of ballet injuries in the greater Durban area.

Procedures:
The ballet dancers will be required to complete a questionnaire about dance injuries, where and how they occur. The average time for the ballet dancers to complete the questionnaire will be 15 – 30 minutes.

Benefits: Should they be suffering from any injuries during the course of their participation in this research, they are offered 2 optional free treatments at the Chiropractic Day Clinic at the Durban Institute of Technology. Also the results of this research will be forwarded to you as the Principal of the Ballet School to allow for improved recommendations with regard to training.

Risks/ Discomforts and Cost:
There are no risks / discomfort or cost involved from participation in the study.

Confidentiality:
All patient information is confidential and the results will be used for research purposes only. You have the right to be informed of any new findings that are made and you may ask questions of an independent source if you so wish. If you are not satisfied with any area of the study please feel free to contact the Durban Institute of Technology Research Ethics Committee.
If there are any questions please do not hesitate to contact myself, Kate Balding or my supervisor Dr Korporaal at the above mentioned numbers,

Yours sincerely,

Kate Balding (Chiropractic Intern) **Dr. C. Korporaal** (Supervisor)

I (name) ______________________ hereby give Kate Balding consent to conduct the above mentioned research at this Ballet School.
Signature:______________________ Date:_________

APPENDIX F

Informed Consent Form

(To be completed by members of the focus group)

Date: February 2003-02-22

Title of research project: The incidence and prevalence of dance injuries in ballet dancers in the greater Durban area.

Name of supervisor:	Dr. C. Korporaal	(031-2042611)
	Dr. A. Jones	(031-2042244)
(Wednesday)		
Name of Research Student:	Kate Balding	(031-2042205)
Name of Institution:	Durban Institute of Technology	

Please circle the appropriate answer

1. Have you read the patient information sheet? YES/NO
2. Have you had opportunity to ask questions regarding this study? YES/NO
3. Have you received satisfactory answers to your questions? YES/NO
4. Have you had an opportunity to discuss this study? YES/NO
5. Have you received enough information about this study? YES/NO
6. Who have you spoken to regarding this study?________________________
7. Do you understand the implications of your involvement in this study?YES/NO
8. Do you understand that you are free to withdraw from this study? YES/NO
   a) at any time?
   b) without having to give a reason for withdrawing?
   c) without affecting your future health care?
9. Do you agree to voluntarily participate in this study? YES/NO

IF YOU HAVE ANSWERED NO TO ANY OF THE ABOVE, PLEASE OBTAIN THE NECESSARY INFORMATION FROM THE RESEARCHER AND / OR SUPERVISOR BEFORE SIGNING. THANK YOU.

PLEASE PRINT IN BLOCK LETTERS

FOCUS GROUP MEMBER_____________SIGNATURE__________________

WITNESS'NAME_____________________SIGNATURE___________________

RESEARCHERS' NAME ______________SIGNATURE___________________

SUPERVISORS' NAME________________SIGNATURE___________________

APPENDIX G

LETTER OF INFORMATION

(Focus Group)

Dear Participant,

Welcome to the focus group of my study. Thank you for your interest.

The title of my research project is: **The incidence and prevalence of dance injuries in ballet dancers in the greater Durban area**.

Name of supervisor:	Dr. C. Korporaal	(031-2042611)
	Dr. A. Jones	(031-2042244)
(Wednesday)		
Name of Research Student:	Kate Balding	(031-2042205)
Name of Institution:	Durban Institute of Technology	

The purpose of this focus group is to validate the use of the Treatment Record Questionnaire in terms of gathering information from ballet dancers. The discussions will focus on the changes that are necessary in order to alter the Treatment Record Questionnaire into the ballet context.

Your participation is much appreciated and it is assured that your comments and contributions will remain confidential. You are at any point permitted to disagree, however if this is the case, please give your reasons for this as it will assist in the research process. The results of this focus group will only be used for research purposes.

Thank you for your participation,

Yours sincerely,

Kate Balding (Chiropractic Intern)

Dr. C. Korporaal (Supervisor)

APPENDIX H

TREATMENT RECORD OR SOAPE NOTE:

NAME:______________________________
TEAM:___________________________
SPORT: Player Ump Coach Manager Official MedTeam
Other___________
POSITION:___________________________
AGE:____________________________
RACE: W B IN OTHER:______________ YRS
EXPERIENCE:_______________
NO. OF GAMES PARTICIPATED IN THIS
TOURNAMENT:_____________________

NEW PATIENT NEW CONDITION
REPEAT PATIENT CONTINUATION OF CARE

LOCATION:

HEAD/CONCUSSION	QUADRICEPS	SHOULDER
NECK	HAMSTRINGS	ELBOW
THORACIC	KNEE	FOREARM
LOWBACK	SHIN/CALF	WRIST
RIBS	ANKLE	HAND
HIP	FOOT	FINGERS

MECHANISM OF INJURY: PRACTICE DURING PARTICIPATION

RUNNING	SPRINTING	SIDE STEPPING
COLLIDING	SLIDING	TACKLING
DURING PREVIOUS GAME	DURING TRAINING	

HAVE YOU INJURED THE AREA BEFORE? YES NO
DID THIS INJURY PREVENT YOU FROM PARTICIPATING IN THE TOURNAMENT? YES NO

CLINICAL IMPRESSIONS: ACUTE CHRONIC

ABRASION	CONTUSION	PUNCTURE	LACERATION
BLISTER	HEAT EXHAUSTION	HEAT STROKE	SPRAIN
STRAIN	DISLOCATION	FRACTURE	MYOFASCIAL
C/FACET	T/FACET	L/FACET	
COSTOCHONDRAL			
SI SYNDROME	TENDONITIS	PFPS	SYSTEMIC DX
NEUROLOGICAL	CIRCULATORY	JOINT DYSFUNTION:_____________	
GENERAL MUSCLE TIGHTNESS			

TREATMENT	MANIPULATION	MOBILISATION	MASSAGE
MYOFASCIAL	NEEDLING	STRETCHING	STRAPPING
ICE	EXERCISES	CROSS FRICTION	

CONTINUATION OF PLAY
RESTRICTED:______________________
HOSPITAL: YES NO **REPORTABLE:** YES NO

TREATMENT BY: DC
(SIGN)____
DC STUDENT (NAME)
____

APPENDIX I

FOCUS GROUP DISCUSSION

TRANSCRIPT OF THE TAPE RECORDINGS.
22 February, 2003

Introduction

For my research I am going to do a prevalence study on ballet injuries in South Africa. Now there is a treatment record questionnaire that gets done at different sports events for Chiropractors to fill in, just about how people are injured, what treatment they get given and things like that. I need to convert it into something that we can use for ballet injuries. So we are going to go through the questionnaire, each question at a time and if you can just give your input, if you disagree or agree with anything or if you have anything that you want to add, please just say it.

You all have a letter of information which is about this group and a letter of informed consent if you could just fill it in. The treatment record is what we are going to go through.

Are you ready? Can we start?

Each question that we go through I want you to think how you would put it into ballet terminology or ballet words; and if you understand each question that it is asking, think of a different way of asking it.

The first thing is name. Team if you think of a hockey match there are different teams. How would you change that to be something that fits in with ballet? Can you think of a different way of putting it?
You are only doing ballet?
Yes, only ballet.
Why can't we call it the studios name?
Yes, studio or company.
Just put in brackets ballet.

Under sport is there anything you can think of to change, there they have got player, umpire, coach. Now obviously in ballet we don't have that.
We don't have any umpires; we could do with a few.
Instructor. Student.
Is there anything else you could add?
Wouldn't you rather call it teacher?
Student. Teacher.

Position?

Position, couldn't that be level? Like intermediate, advanced.
Ok, so if you called it level would anyone who filled it in understand that?
Grade.
What do they have on our exam entry forms?
On our exam sheets it says grade or level. Grade/ Level
And if they were professional dancers?
Then you just put professional.

Age and race
Stays the same

Years experience? What do you understand by that?
How long you have been dancing for.
Wouldn't that only apply to professional dancers? Because if you are in intermediate, you are in intermediate. People would know.
No, you could be in intermediate and only have danced for 3 years or you could be in intermediate and have danced for 10 years.

Number of games participated in this tournament. This applies for things that we work at, like hockey tournaments were they have each played a certain amounts of games in the tournament.
We could change it for ballet into classes per week. Or how many examinations. Shows. Or hours per day.
Exams won't reflect the hours of training.
Hours per week.
Do you think hours per week rather than classes per week?
Yes
Hours per week/ day. Day/week.

New patient and repeat patient. That is the next thing down on the form and new condition and continuation of care.
Yes that will stay the same.

Location of the injury. Can you just read through the list that is there and see if there are areas if you don't know where they are or what they are, or if there are any other areas which you can think of that dancers injure that is not written on the list.
What about pelvis. I don't know if you classify that as hip or lower back area. Or SIJ.

And mechanism of injury? Has everyone finished reading mechanism of injury? Do you know what that means?
That is how the person injured themselves.
Obviously these ones have been written by sports people so this is where we especially have to change, if you can think of the most common ways that ballet dancers injure themselves

Stretching
Not warming up
Lack of preparatory work
Can we do jumping? Yes ok, then jumping
And obviously do you think that it would be better to use jumping compared to allegro?
Yes, because of modern injury. Its still dance. But we are doing ballet?
Yes but it is important for the lay person to understand.
Yes.
Maybe if you want to relate it balletically you should perhaps qualify it by saying jumping/ allegro. Then it would give an indication then that…
Maybe we could say kind of incorrect placements like at the barre, if you are rolling.
And would you say incorrect placement rather than rolling?
Yes, I would say incorrect placements.
What about lifts and things?
Yes, partnership work.
Falling
What about your feet? Pointe work injuries and stuff. I don't know if that would apply to anything that you could help.
What about twisting? Because you could get an injury form doing a spiral because now you have suddenly got to do a spiral in advanced or something.

We are presuming that these people are under the control of a qualified person?
The person who is doing this, filling out will be qualified.
We are presuming that.

What about the difference between practice and performance?
Does that cover everything to do with practice or performance?
Does that mean practice at home as well as practicing in the studio?
Do you think we should separate class from performance?

Any other mechanisms of injury?
Overworking
Straining
Over extension, over extending. Insufficient rest.
And not eating correctly. It's a huge problem.
Do you think that is something like you could say to them? Is that a question you could ask?
Their diet, you could ask their diet. Inadequate diet.
That is not really a mechanism of injury. It is more a question you could ask.
You could get an indication. The injury could be caused by inadequate diet. You are more likely to get an injury if you are not eating properly.
They won't know that
Then you could ask them are you dieting?
Or do you think inadequate diet is something that you should deal with later on?

I think so. A separate question.
Yes.
Yes because you are going to have to also look at other sports or activities that the do, other than dancing.

Are there any others that you can think of at the moment?
You are keeping this form only to ballet or dance in general?
What is your title?
Its ballet.
Ok.
No that is fine. I was going to say to you floor work but in ballet we don't do much floor work.
Performing
I think also, for me, a lack of knowledge of how the body works, to a degree. So that you are uncertain yourself as to how far you can actually extend yourself. I think in terms of the way we teach we do a lot of time talking and explaining about why do we stand like this, what for. I mean what a sill\y way to stand. You have got to understand, a lack of understanding of how to use your body correctly.
And what about the way that we stand?
Abnormal.
We were not made to stand with our feet to one side that is why we have got to understand why. And how to execute that stance correctly.
And then do you think that again should fall under mechanism of injury or as a separate question?
I think that that is a very good separate question.
And then as you were saying about the posture that we use, do you think that could be used as a mechanism of injury?
If you are standing incorrectly
Standing badly.
The two can be very seriously related.

Can we move on to the next question?
Yes

The next 2 questions – have you injured the area before and did this injury prevent you from participating in this tournament?
Absolutely.
Changing participating in this tournament to dancing.

What about adding on another question like if you danced on that injury did it make it worse?
Ok.
Shouldn't you maybe ask or have you already asked if they have got other injuries? Maybe it is related to where they are injured elsewhere?
Ok, so related injuries.

Yes because people compensate. They compensate don't they.
So would that again be a separate question other than mechanism of injury?
Yes.
So, how would you word that?
Participating in a class situation or….Class/ performance situation

Are there any other questions that you think should be asked? We have done inadequate diet, having an understanding of posture, if you have danced on injuries have you exacerbated it, are there any related injuries, more than one injury, are you compensating for it. Is there anything else you can think of?
Related to it as well maybe exhaustion. Dancers seem to just dance and disregard anything else.
They have to dance no matter what, with an injury or tired.
The show must go on sort of attitude.

Maybe what other exercise they do as well.
Lots of people run or do something to keep fit.
And to what extent they do that exercise, and how many hours they do.
Socially or professionally.

Are there any other questions?
Have you asked how long have they had this injury?
No.
When did it first come out? As it could have started as a niggle and then developed into something, or it could have started suddenly.

Sorry just something you said just now about socially or professionally. I don't know if that needs to come into it because whether we are dancing for our own enjoyment or for ……. No, I was talking about other sports, whether we do other sports.

Maybe they should describe the injury. What position it hurts in.
Basically can you reenact what the person's symptoms are.
Like aggravating and relieving factors, something like that.

Sometimes your body automatically compensates doesn't it. Without you being aware of it. So in actual fact you can have a problem with your foot but it is not your foot at all it's your back.
So how would you ask that on a questionnaire like this?
I think that would come into do you have any other injuries? Like if your back is sore, and your foot is sore.
Very often it is none at all. I had a dancer once who complained bitterly of her feet. She went to a specialist straight away and she said stand for me so she stood and she said onto the bed and she said it's nothing to do with your feet it's your back. She ended up having a major back operation. It was nothing to do with her feet at all.

And that again comes from posture that we stand in.., stand turned out or ….
Yes if it is not danced and understood, and one does not execute it correctly, absolutely. Absolutely.
And that again would fall under inadequate knowledge of what you are really doing.
Incorrect training.
What about, as you said, incorrect training? Would that be training under a qualified teacher?
Must be qualified, yes.
Yes if you think of a little sausage-pie that comes to you and the teacher is totally unaware of what is required of the body and she rolls in very badly and the knees fall forward. If that is allowed to continue then that little sausage-pie is definitely not being trained correctly. It is quite a serious facet.
If they put them on pointe too early.
Absolutely.
Stretching them young.
What about, you said, having an injury and then dancing on it.
What about dancers who have injuries, then it goes away? Then it comes back, and then it goes away, comes back….Do you think that should be addressed?
There is a problem isn't there? There is a deep suited healing problem that needs to be addressed.
Could that not also be addressed under how long they have had the injury?
Yes.

Further down the page is the something called clinical impression, now a lot of it is diagnostic terminology there. So the medical people, and the ballet teachers, you will know quite a bit about anatomy and ballet injuries, if you can read through that and see if there is any of them that don't apply to ballet injuries or if there are any other diagnoses that aren't there that you think we should add to it.
Is the dancer now reading it and filling in her own question
Yes and the professional.
Maybe it would be quite nice if you yourself could go down each one and enlarge, say what each one of them is.
Do you understand acute and chronic?
Yes
Abrasion. Does that apply? Yes.
Blister
What about strain? That is like a muscle strain. Yes
The next one is cervical facet, that's like neck pain.
This part of the form is what the doctor will be filling it in?
He will ask the question?
No he will assess the patient and fill it all in.
But we can't comment if we are uncertain as it is to what you are asking.
No, I want to know if you think that each condition applies to dance.
SI syndrome is lower back pain…. yes

Neurological, if there are boys definitely. …why boys? Their brains are a little bit slower than the girls. Sorry
General muscle tightness…..yes
Contusions?
Did everyone understand neurological by the way?..... Yes
Contusion, that is a bang? Yes a bruise….ok. Yes
Heat exhaustion…..yes.
Dislocation……yes
The next one is thoracic facet which is kind of mid back pain……yes
Tendonitis……..yes
Circulatory problems……..yes
Puncture. Puncture wounds. Stabbing. I suppose so. You could run into a prop that had a sharp point. There is a possibility! So do you think puncture applies or not? No.
Heat stroke…. yes
Fracture….. Yes
Lumbar facet. Now that is your lower back…..yes
The next one is patellofemoral pain syndrome which is knee pain…..ok
Joint dysfunction……yes
Laceration. Like a cut. Do you think that applies? I don't think so
Sprain……yes
Myofascial. Now myofascial is muscles, muscle pain….yes
Chostochondral syndrome. Its almost rib pain. Does that apply? Yes.
And systemic disease? Any other diseases the patient might have, that they would have before…..yes

Ok, the next one is treatment and that is just the treatment that the chiropractor will use.

Are there any other questions or anything else that you want to add?
Is there anything else that you think needs to be added in?
What do you call it when muscles pull off from the bone? They actually start tearing off.
Muscle tear? They had a different word for it.
That is what physically happened to you isn't it? Yes. I know they had a word for it….did he/she refer to it technically? Yes.
Avulsion.
In your treatment you haven't got rest. ….rest, ok.
And also under diet and that what about dehydration?

Is there anything else that you think needs to be assessed when a dancer comes in?
Their brain.

Also think of it this way, if you have got this questionnaire and we are collecting the information based on this questionnaire what else would you like to know about dancers? In terms of their injury or potential ability to get injured?

Maybe how old they were when they started dancing. Because if you dance from quite young and if you are not trained properly from then, that could be related to injury.
But what about going back to when they started, other things that they did as well. Most dancers have done something else, rhythmic gymnastics or…. I mean perhaps even a greater breakdown of year's experience.

I was going to say from a professional point of view what ballets they are dancing in. Some classics are more demanding on the body that others. But that would only be on a professional level, not the ones in training.

What about the different types of ballet? Ceccheti, RAD or doesn't that make a difference?
No, no I don't think so.
Don't they put ceccheti dancers onto pointe earlier? ….Yes, that's a thing they do. Yes but their training at a lower level is more demanding then ours (RAD) so they are stronger.
Then again it goes back to the teacher. How good she is and how professional she is in her way of training. There are some that will drive a dancer absolutely and completely to exhaustion. He is totally exhausted and the body is exhausted. He can't perform. The brain mentally becomes dull, physically they are inadequate, they are tired. So they are lethargic aren't they? So they under perform.

Do you think in speaking in terms of the neurological approach that emotionally the dancer can be affected according to the parental attitudes?
Yes, I agree, parental and teacher attitudes.
Dancers are very emotional people.
If you are training a young dancer who is looking toward a professional career there should be a continual interaction between parent/ teacher because what you say should be the same as what the parents are saying so the child is focused and is on the right track straight way. It is not confused.
Do you think that should be addressed on the questionnaire?
Well to me it is very important.
Would you put that under emotional stress?
Yes, very much so.
Ok and where would that fit?
It should be an extra question, just to ask if they are under emotional; stress.
If there is a degree of insecurity that child will underachieve. Underachieving, as in physically under achieving?
Or over achieving? It could work both ways.

If the parents are demanding or at this stage if the parents have now decided that this child is going to dance, because she should have improved, then it is what she wants instead of the child and the child will have to be pushed to over achieve. Alternatively, the child might be so confused between what she says and what the parents say and what the teachers say that she actually gives up. It can work in two directions, it's a no win situation then, isn't it.

What about previous injuries that a dancer has had? Do you think that is important? Yes.

Their dedication to their training as well?
Anything else?
Any compensations?
What about treatment they have previously received?

Don't you think you will have to go into more detail just about their diet? Won't that be asked on a more personal basis? It can be very much related to further down the page.
As a dancer teacher what kind of questions would you ask on diet?
Well you need to approach it very carefully because the last thing you want to do is indicate that there might be a problem because once you plant an idea into a child's head it can have very negative vibes and a negative influence on them. So one approaches the subject very carefully: are you eating well, are you eating 3 times a day. In a one-one situation you can tell by the child's reaction, facial reaction, quite majorly, is to how the child is feeling about that particular subject.
So for this study do you think that diet is really something that needs to be approached?
As far as injuries are concerned, yes.
What about working out their BMI.
That is working out how tall you compared to how much you weigh. There are different levels that indicate if you are underweight normal or obese.
So then you need a thing for height and weight under personal information.

Are there any questions that you think as teachers or with rehab that you think need to be addressed so that dancers can, from a study like this they can make recommendations to teachers afterwards to say that these are the kind of injuries that people are getting, these are the most common, how to go about…..

I was just going to say, in an acute injury how was it treated immediately?
Yes, few people know how to treat an injury straight away. What the dancer did?

What about a weak area in a dancer's body like their back, stomach? They dance with a weak area and it's not really strengthened.
Where would that fit in the questionnaire? Would that also be an extra question?

So for that question would you say are there any areas that you consider to be weak areas or that your teacher tells you is a weak area? And then do you do anything to strengthen it?
Taking responsibility for the advice and suggestions given by the teacher. The child very rarely takes responsibility for that. They feel that coming to class is where they should be instructed, meanwhile once instructed they do nothing about it themselves. They don't take any responsibility to correct that which is advised.
So then what about, with that, do you stretch at home, do you do any strengthening work at home? They possibly wouldn't think of that as other exercise. Other exercise a dancer does might be going for a run, or swimming not doing home stretching.
It relates back to being correctly advised as to how to execute that work.

Shouldn't you ask them if they have goals? A professional dancer may come to you and they have to perform in a couple of weeks and they want you to cure them in a certain amount of time. You can't book them off and tell them not to dance for 6 weeks.

Couldn't you have a family history of joint problems or problems that may be hereditary?
Or back problems.
Or very stiff.
Oh you mean like not flexible?
Scoliosis.
What about what happens to older people, what is it, arthritis?
Osteoporosis

And if we go back to the injuries a dancer has what questions do you think we need to ask around the injury? Other than how they hurt themselves.
Is it sore all the time? Weight bearing
Perhaps you should do a detailed description of each injury. When did it start, how long it has been going on for, what is the course of the injury,
And do that for each injury, if they have got previous injuries too. Do a detailed description of each. And weight bearing and non weight bearing.

And anything you can think of, like what happened before the injury, what happened with the injury, and after the injury.
Are there certain movements that cause it to be worse than others?
What about is it sore when you are sitting or only when you are dancing? Sometimes when you are warmed up these areas are not sore but when you cool down it comes back.

From a dancer's point of view, what are you working on? What kind of a floor do you dance on?
Now will the floor come under mechanism of injury or not? No.

Environmental.
Are there any other things you could put under environmental?
I don't know whether old pointe shoes would make a difference? I am not a dancer. Yes, if you are dancing on a broken shoe.
Do you think that pointe shoes could make a difference to an injury?
Absolutely
Yes, their size and fitting.
The shape of the dancers foot, is it conducive to pointe work?
Anything else under environmental?
Obviously the weather. Perhaps you are more likely o be injured if it is cold.
If it is hot you can push your legs more.
That is what I say too. It is hot today, you can stretch.
What about how long the dancers warm up before they dance? What amount of time? Do they do a 15 minute warm-up?
Also warming down. We don't warm down. It is very rare to see a dancer warm down. You rush out of class with out your shirt on. Yes, we do a curtsey and we run away.
I know I am just wondering why we don't warm down?
Because we want to go home. Sorry!

What about out of class. For me when I go to varsity I always get bad posture because I have like a shoulder bag, and I have to make sure I keep changing shoulder or else I get a sore back and then that, that, whenever I dance it makes it worse.
And also carrying a shoulder bag or prolonged carrying makes your whole body squiff. That's why I had to go to the chiropractor because my whole body was out. But like permanently out.
But now would you class that as a dancing injury?
No, an injury due to the environment that dancing aggravates.
How would you word that in a questionnaire way?
Like I know a lot of people sit and write with bad posture. You could ask if there are any prolonged postures that you can think of that you have.
Would that come under other exercise?
No because you don't think of carrying your bag as exercise. It might be but…
Would that be environmental?
Yes
Poor posture.
I know often if you go to the physio they ask all questions and half the time you haven't actually thought about things like that. Like they say which positions cause the injury to become worse? If you have more comprehensive questions that might work.
Are there other questions that you think should apply?
What kind of shoes do you wear normally? Kids running around in these huge shoes. And parents allow their children at a very early age to wear them, but it's to do with the corporate world isn't it. Fashion.

Going back to the length of warm up and warm down do you consider then barre as warm up?
No.
What about, you were saying, mechanism of injury and you suggested allegro. What about other things, like adage, barre, pirouettes? Could you add all that in?
Yes because pirouettes can rip your knee and your neck as well.
Wouldn't pirouettes come under falling? But depending if you fell or not. Or incorrect placement.
Sometimes you whip your head really fast and you get a sore neck, but you don't fall. Nobody whips their head though, lets be honest here.
Adage also, you can get a lot of injuries from adage
Under what heading would you put that?
Ok, but now I don't know if you could just go on with everything. Because now even pointing your foot could cause you to be injured.
Ok that's true.
But I mean even starting position. Starting from a bad position.
Would that not come under posture and incorrect placement?
You could just have a separate heading under what part of the class you got an injury. Just because then you would know, it would help you know, that dance injuries occur mostly here and when dances are doing ….
You generalize, just breaking the class down.
Now if you were going to break the class down what would you break it down into?
Barre, centre practice, pirouettes, adage, the usual, allegro, pointe work.

Any other questions you can ask around injuries
What about have you been taking any medication? Anti inflammatories?

What about injuries in teachers?
Yes, I periodically get kicked. When you demonstrate something without having warmed up.

Any other things, going back to medication?
Have they channeled their injuries in the right direction? You can't just go to anyone, really. To any physio or …
Some of them specialize in injuries. You have to seek out the avenue that is best for you.
And with the physio could you ask them about the treatment that they have had?
Do you think it is important to ask how long they had treatment for? How many sessions? Did it go away?
Did it recur? And also if they actually had proper rehab at the end of it. Have they allowed themselves?
Would it be ethical to ask who?
No.

How did you feel? I mean you have passed your ballet exam. You played by the rules didn't you? Immediately after you didn't play by the rules really.
No I didn't do anything. They just said I had to keep icing it and I just left it. I couldn't do anything. I couldn't run, I couldn't cycle. For about 4 months. It does come back. Apparently it is fully healed; it just does ache now and again.
It is weak. I think perhaps it is a scar, because the become muscles scarred, don't they? If they are over extended. That is obviously what happened because you continued to work when you shouldn't have done.
Yes, they all kept saying to me not to do it, but I had my ballet exam coming up. I mean the physio kept telling me to ice it and make sure you strap my foot, and anti inflammatories and the whole lot. I kept doing that and afterwards I just stopped.
But you had an injection of cortisone didn't you?
Yes I had a cortisone injection in my foot. It doesn't hurt, it numbed it.
And you danced on that?
Yes, I don't think that was very good.
That is related to your previous question.

So do you think you could ask when you injured yourself did you rest, did you dance on it?
See that was my question too. It is clear that whomever it was allowed themselves to be persuaded to inject so that she could perform but my question to you, which is probably a personal one , how you would feel about that, would you go ahead with it or would you back off because you personally feel it horribly wrong for that child.
Well we are not allowed to inject.
You are not allowed to inject? To me it is a tricky one.
There is a difference in carrying on and performing and carrying on with gentle practice.
You kept saying you were going to be fine and you continued didn't you? We should have severed it there and then, stopped it straight away.
It is actually, I kind of lied to the sports physician. He said that if it gets a bit better and if it doesn't keep hurting on pointe work then I will give you an injection. I said no, its fine, its fine but it was sore and I didn't want to give up my exam, so I just kept dancing.

But that's another question, like most of us lie.
Yes, you lie. Are you telling the truth?

It's like before I went overseas I had a scan because they thought I had a stress fracture. I carried on dancing any way and I had excessive treatment everyday and I went overseas and as soon as I got there it just got so much worse than it had been and I ended up dancing for 2 months on it, now it keeps coming back, so now I think I have to go for more scans, so you should actually listen to physios and chiros. They know best.
I mean dancers do, they lie because all they want to do is dance.

When you were over there what was the climate like. Was it cold or hot?
Very hot.
Very hot. Like 43° every day.
Where about were you? New York.

Do you think that that is the kind of thing you can address in a questionnaire?
Do you lie?
Don't you have to sign a statement at the bottom? I have not lied.
It's not so much that you lie its just that have you continued to dance when advised otherwise.
You see the thing is that you mustn't actually ever do that. You mustn't because you are going to grow older.
I think the problem is that dancers have a view that their career is 10 years long, they don't ever think of the 50 years after that.
You also don't see the older dancers who are battling to walk, who are osteoporotic.

Is there anything else that you would like to see in the questionnaire?
You deal with dancers all the time. Is there anything that you might like to find out about injuries?

I think we have pretty much covered it. I would have liked to have seen this in advance and then given it more serious thought or is it meant to be spontaneous?
Spontaneous.

Thank you very much for your help.
It has been hard brain work this afternoon.

APPENDIX K

RESULTS OF THE INDEPENDENT T-TESTS

Note:

Q14 – Have you ever sustained an injury from ballet?
1=yes
2=no

Q3 – Age in years
Q4 – Height (cm)
Q5 – Weight (kg)
Q9 – Age of ballet onset
Q11 – Years of ballet experience
Q52 – Statistical mistake, not used
Q53 – Body Mass Index

Q37 – Are you presently suffering from an injury due to ballet?
1=yes
2=no

Results for the lifetime incidence group (n=74)

Group Statistics

	Q14	N	Mean	Std. Deviation	Std. Error Mean
Q3	1	74	17.73	4.95	.58
	2	26	14.23	2.10	.41

Group Statistics

	Q14	N	Mean	Std. Deviation	Std. Error Mean
Q4	1	74	162.8514	9.3993	1.0927
	2	26	159.6154	7.2226	1.4165
Q5	1	74	51.5770	6.9221	.8047
	2	26	47.4231	7.6062	1.4917
Q9	1	74	5.49	3.65	.42
	2	26	4.38	1.81	.36
Q11	1	74	12.33	4.58	.53
	2	26	9.35	2.34	.46
Q52	1	74	1.28	.69	8.05E-02
	2	26	1.00	.00	.00
Q53	1	74	19.4699	2.3410	.2721
	2	26	18.5727	2.4619	.4828

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q3	Equal variances assumed	11.953	.001	3.484	98	.001	3.50	1.00	1.51	5.49
	Equal variances not assumed			4.940	94.480	.000	3.50	.71	2.09	4.91

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q4	Equal variances assumed	1.251	.266	1.596	98	.114	3.2360	2.0278	-.7882	7.2602
	Equal variances not assumed			1.809	56.725	.076	3.2360	1.7889	-.3467	6.8186
Q5	Equal variances assumed	.156	.694	2.565	98	.012	4.1540	1.6193	.9405	7.3674
	Equal variances not assumed			2.451	40.493	.019	4.1540	1.6949	.7297	7.5782
Q9	Equal variances assumed	4.382	.039	1.473	98	.144	1.10	.75	-.38	2.59
	Equal variances not assumed			1.991	86.699	.050	1.10	.55	1.58E-03	2.20
Q11	Equal variances assumed	6.175	.015	3.172	98	.002	2.98	.94	1.12	4.85
	Equal variances not assumed			4.243	84.811	.000	2.98	.70	1.59	4.38
Q52	Equal variances assumed	24.784	.000	2.082	98	.040	.28	.14	1.33E-02	.55
	Equal variances not assumed			3.524	73.000	.001	.28	8.05E-02	.12	.44
Q53	Equal variances assumed	.225	.636	1.659	98	.100	.8972	.5409	-.1761	1.9705
	Equal variances not assumed			1.619	41.957	.113	.8972	.5542	-.2213	2.0157

Results for the Prevalence group (n=30)

Group Statistics

	Q37	N	Mean	Std. Deviation	Std. Error Mean
Q3	1	30	18.00	5.25	.96
	2	70	16.31	4.31	.51

Group Statistics

	Q37	N	Mean	Std. Deviation	Std. Error Mean
Q4	1	30	164.8667	8.7326	1.5943
	2	70	160.7857	8.8414	1.0568
Q5	1	30	53.1667	6.7317	1.2290
	2	70	49.3529	7.2797	.8701
Q9	1	30	6.53	4.70	.86
	2	70	4.63	2.29	.27
Q11	1	30	11.77	4.65	.85
	2	70	11.46	4.19	.50
Q52	1	30	1.33	.76	.14
	2	70	1.16	.53	6.32E-02
Q53	1	30	19.5646	2.0356	.3716
	2	70	19.0961	2.5318	.3026

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q3	Equal variances assumed	1.668	.200	1.678	98	.097	1.69	1.00	-.31	3.68
	Equal variances not assumed			1.550	46.533	.128	1.69	1.09	-.50	3.87

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Q4	Equal variances assumed	.189	.665	2.123	98	.036	4.0810	1.9224	.2661	7.8958
	Equal variances not assumed			2.134	55.570	.037	4.0810	1.9128	.2486	7.9133
Q5	Equal variances assumed	.323	.571	2.454	98	.016	3.8138	1.5541	.7297	6.8979
	Equal variances not assumed			2.533	59.112	.014	3.8138	1.5059	.8007	6.8269
Q9	Equal variances assumed	11.146	.001	2.730	98	.008	1.90	.70	.52	3.29
	Equal variances not assumed			2.116	35.068	.041	1.90	.90	7.77E-02	3.73
Q11	Equal variances assumed	.350	.555	.320	98	.750	.30	.95	-1.57	2.18
	Equal variances not assumed			.307	50.137	.760	.30	.99	-1.68	2.28
Q52	Equal variances assumed	7.084	.009	1.333	98	.186	.18	.13	-8.60E-02	.44
	Equal variances not assumed			1.158	41.580	.253	.18	.15	-.13	.48
Q53	Equal variances assumed	2.208	.141	.896	98	.372	.4685	.5228	-.5690	1.5060
	Equal variances not assumed			.978	67.695	.332	.4685	.4793	-.4879	1.4249

APPENDIX J

Questionnaire number: ____________________

Durban Institute of Technology: Department of Chiropractic

An epidemiological investigation of dance injuries in ballet in the the greater Durban area

Name: ____________________ Tel. (home): ____________________

Tel. (work): ____________________

Ballet company/studio: ____________________

Ballet grade/level: ____________________

Student	Teacher	Professional

Please place a cross in the appropriate box. Please answer all the questions.

Section 1: Personal information

1. Gender?

Female	Male
01	02

2. Which ethnic group do you belong to?

Black	White	Coloured	Asian
01	02	03	04

3. What is your age (in years)? ______ years

4. What is your height (in centimeters)?: ______ cm

5. What is your weight (in kilograms)?: ______ kg

6. What other sport/exercise do you perform on a regular basis? ____________________

7. How would you describe your dietary habits?

Poor	Adequate	Good	Excellent
01	02	03	04

8. How would you describe your emotional stress levels?

Very high	High	Average	Low	Very low
01	02	03	04	05

Section 2: Ballet history

9. At what age did you start ballet? ______ years old

10. Since you started ballet, how consistently have you danced (attended class and/or performed)?

Very consistently	Consistently	Irregularly	Very irregularly
01	02	03	04

11. How many years experience do you have in ballet? ________ years

12. At present, how many hours do you dance per week?

More than 10 hrs	8-10hrs	5-7hrs	2-4hrs	Less than 2 hrs
01	02	03	04	05

13. At present, how many ballet classes/sessions do you dance per week?

7 or more	6	5	4	3	2	1
01	02	03	04	05	06	07

Section 3: Previous ballet injuries

14. Have you **ever** sustained an injury from ballet dancing?

Yes	No
01	02

15. How often have you sustained injuries from ballet?

1 injury / month	1 injury / 3 months	1injury / 6 months	1 injury / 12 months	No injuries
01	02	03	04	05

16-25. How often have the following areas of your body been injured during ballet?
(This includes any injuries from ballet, sustained at any time during your ballet career)

	01	02	03	04
16. Foot/toes	Very often	Often	Seldom	Never
17. Ankle	Very often	Often	Seldom	Never
18. Achilles	Very often	Often	Seldom	Never
19. Leg (calf/shin)	Very often	Often	Seldom	Never
20. Knee	Very often	Often	Seldom	Never
21. Hamstrings (back of thigh)	Very often	Often	Seldom	Never
22. Quadriceps (front of thigh)	Very often	Often	Seldom	Never
23. Hip/groin	Very often	Often	Seldom	Never
24. Low back	Very often	Often	Seldom	Never
25. Other	Very often	Often	Seldom	Never

If "other", please specify: ________________________

26. Consider the worst injury you have sustained during ballet. How would you describe the severity of this injury? (Please mark "N/A/"not applicable" if you answered "No" to Quest. 14)

N/A	Mild	Moderate	Severe
01	02	03	04

From the list above (Q.16-25), please state the area that was injured: ________

27-36. How have injuries to any of the areas listed belo low effected your dancing?
(Please mark "N/A" if you answered "No" to Quest. 14)

	01	02	03	04
27. Foot/toes	Prevented dancing	Limited dancing	No effect	N/A
28. Ankle	Prevented dancing	Limited dancing	No effect	N/A
29. Achilles	Prevented dancing	Limited dancing	No effect	N/A
30. Leg (calf/shin)	Prevented dancing	Limited dancing	No effect	N/A
31. Knee	Prevented dancing	Limited dancing	No effect	N/A
32. Hamstrings	Prevented dancing	Limited dancing	No effect	N/A
33. Quadriceps	Prevented dancing	Limited dancing	No effect	N/A
34. Hip/groin	Prevented dancing	Limited dancing	No effect	N/A
35. Low back	Prevented dancing	Limited dancing	No effect	N/A
36. Other	Prevented dancing	Limited dancing	No effect	N/A

If "other" area, please specify: ______________________________

Section 4: Present ballet injuries

37. Are you **presently** suffering from an injury due to ballet?

Yes	No
01	02

38. Which part of your body is most injured at the moment?
(Please mark "N/A", here and below, if you answered "No" to Quest. 37)

Foot/toes	01	Hamstrings	06	N/A	11
Ankle	02	Quadriceps	07		
Achilles	03	Hip/groin	08		
Leg	04	Low back	09		
Knee	05	Other	10		

If "other", please specify ______________________________

39. How would you describe the severity of this injury?

Severe	Moderate	Mild	N/A
01	02	03	04

40. At the moment, how does your present injury affect your dancing?

Prevents dancing	Severe limitation/pain	Some limitation/pain	No effect	N/A
05	04	03	02	01

41. What is the longest period for which you were not able to dance due to your present injury?

Greater than 6 months	3-6 months	Less than 3 months	N/A
04	03	02	01

42. How long have you had your present injury?

Greater than 6 months	3-6 months	Less than 3 months	N/A
04	03	02	01

43. Which of the following factors do you feel is the most likely cause of your present injury?

Insufficient warm-up / cold	01	Unsuitable floors	08
Stretching	02	Difficult choreography	09
Twisting	03	Repetitive movements	10
Jumping	04	Partnerships	11
Pointe work	05	Falling	12
Insufficient rest / overwork	06	Other	13
Incorrect posture/placement	07	N/A	14

44. During which part of your class was your present injury sustained?

Warm-up	01	Pirouettes	04	Pointe work	07
Barre	02	Adage	05	Unsure	08
Centre	03	Allegro	06	N/A	09

45. Has anyone ever pointed out a weakness in your dancing posture?

Yes	No
01	02

If so, please describe briefly: ______________________________

Section 5: Treatment

46. Have you **ever** received treatment for a ballet injury?

Yes	No	N/A
01	02	03

47. What type/s of treatment have you received?

Rehabilitation	01	Medication/injections	05
Orthopaedic	02	Chiropractic	06
Bracing/strapping	03	Other	07
Physiotherapy	04	N/A	08

48. Have you received treatment for your **present** injury?

Yes	No	N/A
01	02	03

49. What kind of treatment have you received for your present injury?

Rehabilitation	01	Medication/injections	05
Orthopaedic	02	Chiropractic	06
Bracing/strapping	03	Other	07
Physiotherapy	04	N/A	08

50. If you have received treatment / rehabilitation for an injury; how would you describe your compliance with this treatment?

Poor	Good	Excellent	N/A
01	02	03	04