Optimism in the treatment and recovery of secondary medical complications after spinal cord injury

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Abstract

The power of positive thinking to promote and maintain well-being has enjoyed widespread popular appeal. Spurred largely by the development of the Life Orientation Test (LOT) (Scheier & Carver, 1985), mounting evidence now attests to the apparent benefits conferred by an optimistic life outlook. Optimism, the inclination to expect favourable outcomes, has been linked to both psychological and physical well-being (Taylor, et al., 1992; Cheng & Hamid, 1997; Marshall, Wortman, Kusalas, Hervig, & Vickers, 1992; Scheier, Carver & Bridges, 1994; Scheier et al., 1989; Segerstrom, Taylor, Kemeny, & Fahey, 1998).

Optimists and pessimists have been shown to differ in the manner in which they cope with the challenges in their lives. They differ in their stable coping tendencies and in the kinds of coping responses that they spontaneously generate when given hypothetical coping situations (Scheier, Weintraub, & Carver, 1986). Optimists also differ from pessimists in the manner in which they cope with serious disease and with concerns about specific health threats (Friedman, et al., 1992), and these coping mechanisms in optimists in turn have been linked to improved physical and psychological functioning. There is also a clear biological link between optimism and physical well-being and this has been noted in such areas as immune functioning (Peterson & Bossio, 2002). The current study examines these apparent benefits of optimism on health and explores the medical bases for this connection. The study also examines whether these benefits may be of use in the treatment and recovery from the unique secondary medical complications experienced by those who are spinal cord injured.

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He who has health has hope;
and he who has hope has everything
- Arabian Proverb

1. INTRODUCTION

Injuries due to violence and accidents have been acknowledged as one of the leading causes of mortality in developing countries (Robertson, 1992). The Global Burden of Disease Study (Murray, 1997) projected that of all regions in the world, sub-Saharan Africa would show the largest increase in injury-related burden of disease (due to wars, interpersonal violence and transport-related incidents) from 1990 to 2020, unless effective prevention measures were established.

In South Africa, homicide, suicide, and transportation accidents contribute substantially to the burden of disease, especially among the poor and disadvantaged (Van der Spuy, 1996). While road traffic and self-inflicted injuries are the leading causes of injury-related deaths worldwide, violence is a major factor in South African trauma (Van der Spuy, 1996).

The Violence and Injury Surveillance Consortium, comprising the South African Medical Research Council, the University of South Africa and the Council for Scientific and Industrial Research, is currently developing a fatal and non-fatal injury surveillance system to provide national estimates for the incidence and types of injury, risk factors and demographic profiles of injured South Africans. According to the Consortium, some of the largest growing types of injuries include those involving the spinal cord, mainly caused by road accidents and violence. More information can be found on the website of the South African Medical Research Council (www.mrc.ac.za).

At present, it is estimated that an average of 25 000 South Africans fall victim to road accidents every year. Out of these, an estimated 1000 are left partially or completely paralysed with severe spinal cord injuries (SCI). Furthermore gun shot injuries resulting in SCIs, have sky rocketed b y 217% since 1995. Again, more information can be found on the website of the South African Medical Research Council.

The impact of these injuries on the individual and the economy is becoming indubitable, even more so as the majority of these victims are uneducated, unemployed and impoverished. The costs involved in the medical treatment and rehabilitation of a SCI are exorbitant, and the manpower and skills needed to provide the daily care for these individuals is often lacking. Furthermore, the majority of the people who sustain a SCI are aged between 15 and 29, and for every injured female there are five injured males (Van der Spuy, 1996), which means that the predominant portion of the work force of the country is being put under increasing strain. Also, while the majority of injuries occur to young people, it is important to note that the average person with a SCI will live almost as long as a person without a SCI (L. van der Vyver, personal communication, August 24, 2003). This means there is an increasing number of people with SCI who are ageing with their disability.

At present, it is estimated that total psychological rehabilitation after a SCI could take anywhere between three and six years (R. Campbell, personal communication, August 24, 2003) but there does not appear to be any consensus on this issue forthcoming. The rate of depression, anxiety, suicide and other psychological disorders is astronomical in this sector of the community (Trieschmann, 1997) and this too adds to the total burden on society and the economy.

Depression can have devastating effects on an individual with SCI. It is the most frequent post-injury diagnosis in such individuals, and has been linked to the higher utilisation of health services (Trieshmann, 1997). Furthermore, it can be associated with sub-optimal functional gains, increased secondary complications, such as pressure ulcers and urinary tract infections, increased chronic and acute pain, compromised immune function, increased hospital stays, increased medical expenses, decreased social integration, compromised intimate relationships, and strained care-giver support (Trieshmann, 1997). This, in itself, may explain a large proportion of secondary medical complications associated with SCI, but to date little has been researched.

There is a plethora of research on treatment and rehabilitation in the medical sector, related to SCI, but this is often not only beyond the financial reach of the average South African, but is also inadequate in terms of dealing with the holistic nature of this specific disability. Clearly what is needed to curb the financial and emotional burden on society with regard to this specific injury is an alternative and more cost effective focus.

A strongly emerging field in research and treatment of medical disease and injury, psychoneuroimmunology, is shedding new light on this serious impasse. It involves the study of the connection between the mind and the body, and the effect that the interaction between the two has on the individual (Hafen, Karren, Frandsen & Smith, 1996). It is creating new focus in the treatment and prevention of acute and chronic disease and injury.

Of particular interest in this field, is the concept of optimism. Optimism, the belief in a positive outcome, has been extensively researched in the last 15-20 years, and has been linked repeatedly to both psychological and physical well-being. A good deal of research (Taylor, et al., 1992; Cheng & Hamid, 1997; Marshall, Wortman, Kusalas, Hervig, & Vickers, 1992; Scheier, Carver, & Bridges, 1994; Scheier et al.,1989; Segerstrom, Taylor, Kemeny & Fahey, 1998) now indicates that the personality dimension of optimism plays an important role in a wide range of behavioural, psychological, and physical outcomes when people confront adversity.

Optimism has been linked to increased rates of recovery in both depression and several medical disorders as well (Affleck, Tennen & Apter, 2002; Bromberger & Matthews, 1996; Scheier et al., 1989; Taylor, et al., 1992), and current research is proving invaluable within this area of treatment. If optimism can be further proved to be useful in the treatment of both depression and the secondary medical complications which it may cause in patients with SCI, the overall effect on the injured person, as well as the burden of disease in South Africa, may be astounding. It is, therefore, the purpose of this study to attempt to draw these links.

To begin this discussion, however, it is important to understand what can happen as the result of a SCI. It is important to have a sound understanding, not only of the anatomy of the spinal cord and its normal functions, but also a medical overview of how these injuries can effect the biological and emotional functioning of the individual. As such, what follows is a description mapping the function and course of injury of the spinal cord, a holistic view of the spinal cord injured person and an in-depth examination of the concept of optimism and how this may be used in the treatment and recovery of the secondary medical complications experienced by patients with SCI.

2. SPINE ANATOMY

The soft, jelly-like spinal cord is protected by the spinal column. The spinal column is made up of 33 vertebrae, each with a circular opening. The bones are situated one on top of the other and the spinal cord runs through the hollow channel created by the holes in the stacked bones (Austin, 1992).

The vertebrae can be organized into sections, and are named and numbered from top to bottom according to their location along the backbone (Gray, 1977):

- Cervical vertebrae (1-7) located in the neck
- Thoracic vertebrae (1-12) in the upper back (attached to the ribcage)
- Lumbar vertebrae (1-5) in the lower back
- Sacral vertebrae (1-5) in the hip area
- Coccygeal vertebrae (1-4 fused) in the tailbone

Although the hard vertebrae protect the soft spinal cord from injury most of the time, the spinal column is not all hard bone. Between the vertebrae are discs of semi-rigid cartilage, and in the narrow spaces between them are passages through which the spinal nerves exit to the rest of the body (Austin, 1992). These are places where the spinal cord is vulnerable to direct injury.

The spinal cord is also organized into segments and named and numbered from top to bottom. Each segment marks where spinal nerves emerge from the cord to connect to specific regions of the body. Locations of spinal cord segments do not correspond exactly to vertebral locations, but they are roughly equivalent (Gray, 1977):

- Cervical spinal nerves (C1 to C8) control signals to the back of the head, the neck and shoulders, the arms and hands, and the diaphragm.
- Thoracic spinal nerves (T1 to T12) control signals to the chest muscles, some muscles of the back, and parts of the abdomen.
- Lumbar spinal nerves (L1 to L5) control signals to the lower parts of the abdomen and the back, the buttocks, some parts of the external genital organs, and parts of the leg.
- Sacral spinal nerves (S1 to S5) control signals to the thighs and lower parts of the legs, the feet, most of the external genital organs, and the area around the anus.

The single coccygeal nerve carries sensory information from the skin of the lower back.

2.1. Spinal Cord Anatomy

The spinal cord has a core of tissue containing nerve cells, surrounded by long tracts of nerve fibres consisting of axons (Vernon, et al., 2002). The tracts extend up and down the spinal cord, carrying signals to and from the brain. The average size of the spinal cord varies in circumference along its length, from the width of a thumb to the width of one of the smaller fingers (Vernon, et al., 2002). The spinal cord extends down through the upper two thirds of the vertebral canal, from the base of the brain to the lower back, and is generally 15 to 17 inches long depending on an individual's height (Vernon, et al., 2002).

The interior of the spinal cord is made up of neurons, their support cells called glia, and blood vessels (Gray, 1977). The neurons and their dendrites reside in an H-shaped region called "grey matter."

The H-shaped grey matter of the spinal cord contains motor neurons that control movement, smaller inter-neurons that handle communication within and between the segments of the spinal cord, and cells that receive sensory signals and then send information up to centres in the brain (Austin, 1992).

Surrounding the grey matter of neurons, is white matter. Most axons are covered with an insulating substance called myelin, which allows electrical signals to flow freely and quickly. Myelin has a whitish appearance, which is why this outer section of the spinal cord is called "white matter" (Austin, 1992).

Axons carry signals downward from the brain (along descending pathways) and upward toward the brain (along ascending pathways) within specific tracts. Axons branch at their ends and can make connections with many other nerve cells simultaneously. Some axons extend along the entire length of the spinal cord (Gray, 1977).

The descending motor tracts control the smooth muscles of internal organs and the striated (capable of voluntary contractions) muscles of the arms and legs (Austin, 1992). They also help adjust the autonomic nervous system's regulation of blood pressure, body temperature, and the response to stress. These pathways begin with neurons in the brain that send electrical signals downward to specific levels of the spinal cord. Neurons in these segments then send the impulses out to the rest of the body or coordinate neural activity within the cord itself (Austin, 1992).

The ascending sensory tracts transmit sensory signals from the skin, extremities, and internal organs that enter at specific segments of the spinal cord. Most of these signals are then relayed to the brain (Vernon, et al., 2002). The spinal cord also contains neuronal circuits that control reflexes and repetitive movements, such as walking, which can be activated by incoming sensory signals without input from the brain (Vernon, et al., 2002).

The circumference of the spinal cord varies depending on its location. It is larger in the cervical and lumbar areas because these areas supply the nerves to the arms and upper body and the legs and lower body, which require the most intense muscular control and receive the most sensory signals (Vernon, et al., 2002).

The ratio of white matter to grey matter also varies at each level of the spinal cord. In the cervical segment, which is located in the neck, there is a large amount of white matter because at this level there are many axons going to and from the brain and the rest of the spinal cord below (Austin, 1992). In lower segments, such as the sacral, there is less white matter because most ascending axons have not yet entered the cord, and most descending axons have contacted their targets along the way (Austin, 1992).

To pass between the vertebrae, the axons that link the spinal cord to the muscles and the rest of the body are bundled into 31 pairs of spinal nerves, each pair with a sensory root and a motor root that make connections within the grey matter (Austin, 1992). Two pairs of nerves- a sensory and motor pair on either side of the cord - emerge from each segment of the spinal cord (Gray, 1977).

The functions of these nerves are determined by their location in the spinal cord. They control everything from body functions such as breathing, sweating, digestion, and elimination, to gross and fine motor skills, as well as sensations in the arms and legs (Vernon, et al., 2002).

2.2. <u>The Nervous Systems</u>

Together, the spinal cord and the brain make up the central nervous system (CNS) (Gray, 1977). The CNS controls most functions of the body, but it is not the only nervous system in the body. The peripheral nervous system (PNS) includes the nerves that project to the limbs, heart, skin, and other organs outside the brain (Austin, 1992). The PNS controls the somatic nervous system (SNS), which regulates muscle movements and the response to sensations of touch and pain, and the autonomic nervous system (ANS), which provides nerve input to the internal organs and generates automatic reflex responses (Austin, 1992). The ANS is divided into the sympathetic nervous system, which mobilizes organs and their functions during times of stress and arousal, and the parasympathetic nervous system, which conserves energy and resources during times of rest and relaxation (Austin, 1992).

The spinal cord acts as the primary information pathway between the brain and all the other nervous systems of the body. It receives sensory information from the skin, joints, and muscles of the trunk, arms, and legs, which it then relays upward to the brain (Austin, 1992). It carries messages downward from the brain to the PNS, and contains motor neurons, which direct voluntary movements and adjust reflex movements. Because of the central role it plays in coordinating muscle movements and interpreting sensory input, any kind of injury to the spinal cord can cause significant problems throughout the body.

3. WHAT IS SPINAL CORD INJURY?

As mentioned above, the spinal cord is the major conduit through which motor and sensory information travels between brain and body. SCI occurs when a traumatic event results in damage to cells within the spinal cord or severs the nerve tracts that relay signals up and down the spinal cord (Austin, 1992). The most common types of SCIs include contusion (bruising of the spinal cord) and compression (caused by pressure on the spinal cord) (Kottke & Lehmann, 1990). Other types of injuries include lacerations (severing or tearing of some nerve fibres, such as damage caused by a gun shot wound), and central cord syndrome (specific damage to the corticospinal tracts of the cervical region of the spinal cord) (Austin, 1992; Kottke & Lehmann, 1990).

Damage to the spinal cord can also occur if the blood supply (and the oxygen which blood carries) is cut off, or if it is bruised by a bone fragment (Austin, 1992). Severe SCI often causes paralysis (loss of control over voluntary movement and muscles of the body), as well as loss of sensation and reflex function below the point of injury, including autonomic activity such as breathing and other activities such as bowel and bladder control (Austin, 1992; Morgan, Silver & Williams, 1986; Seaton & Hollingworth, 1986). The degree to which functions such as movement and sensation are affected depends on the severity of the damage. The segment of the cord that is injured, and the severity of the injury, will determine which body functions are compromised or lost (Kottke & Lehmann, 1990). In a complete injury, all movement and sensation below the level of the SCI is lost. In an incomplete injury, some of the pathways at the site of the injury are spared, and there may be some sensation below the level of the injury, and some movement of the muscles (Austin, 1992; Kottke & Lehmann, 1990). Other symptoms, such as pain or sensitivity to stimuli, muscle spasms, and sexual dysfunction, may develop over time. Spinal cord injured patients are also prone to develop secondary medical problems, such as bladder infections, lung infections, and bedsores (Kottke & Lehmann, 1990).

Most injuries to the spinal cord do not completely sever it. Instead, an injury is more likely to cause fractures and compression of the vertebrae, which then crush and destroy the axons, extensions of nerve cells that carry signals up and down the spinal cord between the brain and the rest of the body (Austin, 1992; Vernon, et al., 2002). An injury to the spinal cord can damage a few, many, or almost all of these axons. Some injuries will allow almost complete recovery, whereas others will result in complete paralysis (Kottke & Lehmann, 1990).

A SCI usually begins with a sudden, traumatic blow to the spine that fractures or dislocates vertebrae. The damage begins at the moment of injury when displaced bone fragments, disc material, or ligaments bruise or tear into spinal cord tissue (Austin, 1992; Vernon, et al., 2002). Axons are cut off or damaged beyond repair, and neural cell membranes are broken. Blood vessels may rupture and cause heavy bleeding in the central grey matter, which can spread to other areas of the spinal cord over the next few hours (Vernon, et al., 2002).

Within minutes, the spinal cord swells to fill the entire cavity of the spinal canal at the injury level. This swelling cuts off blood flow, which also cuts off oxygen to spinal cord tissue. Blood pressure drops, sometimes dramatically, as the body loses its ability to self-regulate (Weeks, 1992). As blood pressure lowers even further, it interferes with the electrical activity of neurons and axons. All these changes can cause a condition known as spinal shock that can last from several hours to several days (Kottke & Lehmann, 1990; Weeks, 1992).

Although there is some controversy among neurologists about the extent and impact of spinal shock, and even its definition in terms of physiological characteristics, it appears to occur in approximately half the cases of SCI (Austin, 1992; Kottke & Lehmann, 1990; Vernon, et al., 2002; Weeks, 1992), and it is usually directly related to the size and severity of the injury. During spinal shock, even undamaged portions of the spinal cord become temporarily disabled and cannot communicate normally with the brain (Kottke & Lehmann, 1990). Complete paralysis may develop, with loss of reflexes and sensation in the limbs.

The crushing and tearing of axons is just the beginning of the devastation that occurs in the injured spinal cord and continues for days. The initial physical trauma sets off a cascade of biochemical and cellular events that kill neurons, strip axons of their myelin insulation, and triggers an inflammatory immune system response (Weeks, 1992). Days or sometimes even weeks later, after this second wave of damage has passed, the area of destruction has increased - sometimes to several segments above and below the original injury - and so has the extent of disability (Weeks, 1992).

3.1. Changes In Blood Flow Cause Ongoing Damage

Changes in blood flow in and around the spinal cord begin at the injured area, spread out to adjacent, uninjured areas, and then set off problems throughout the body (Austin, 1992; Weeks, 1992).

Immediately after the injury, there is a major reduction in blood flow to the site, which can last for as long as 24 hours and becomes progressively worse if untreated. Because of differences in tissue composition, the impact is greater on the interior grey matter of the spinal cord than on the outlying white matter (Weeks, 1992).

Blood vessels in the grey matter also begin to leak, sometimes as early as five minutes after injury. Cells that line the still-intact blood vessels in the spinal cord begin to swell, for reasons that are not yet clearly understood, and this continues to reduce blood flow to the injured area (Weeks, 1992). The combination of leaking, swelling, and sluggish blood flow prevents the normal delivery of oxygen and nutrients to neurons, causing many of them to die.

The body continues to regulate blood pressure and heart rate during the first hour to hour-and-a-half after the injury, but as the reduction in the rate of blood flow becomes more widespread, self-regulation begins to turn off. Blood pressure and heart rate drop (Weeks, 1992).

3.2. Excessive Release Of Neurotransmitters Kills Nerve Cells

After the injury, an excessive release of neurotransmitters can cause additional damage by overexciting nerve cells (Kottke & Lehmann, 1990).

Glutamate is an excitatory neurotransmitter, commonly used by nerve cells in the spinal cord to stimulate activity in neurons. But when spinal cells are injured, neurons flood the area with glutamate (Austin, 1992; Vernon, et al., 2002). Excessive glutamate triggers a destructive process, called excitotoxicity, which disrupts normal processes and kills neurons and other cells, called oligodendrocytes which surround and protect axons. An invasion of immune system cells creates inflammation (Austin, 1992; Vernon, et al., 2002).

Under normal conditions, the blood-brain barrier (which tightly controls the passage of cells and large molecules between the circulatory and CNS) keeps immune system cells from entering the brain or spinal cord (Austin, 1992). But when the blood-brain barrier is broken by blood vessels bursting and leaking into spinal cord tissue, immune system cells that normally circulate in the blood - primarily white blood cells - can invade the surrounding tissue and trigger an inflammatory response (Austin, 1992; Vernon, et al., 2002). This inflammation is characterized by fluid accumulation and the influx of immune cells: neutrophils, T-cells, macrophages, and monocytes.

Neutrophils are the first to enter, within about 12 hours of injury, and they remain for about a day. Three days after the injury, T-cells arrive. Their function in the injured spinal cord is not clearly understood, but in the healthy spinal cord they kill infected cells and regulate the immune response (Vernon, et al., 2002). Macrophages and monocytes enter after the T-cells and scavenge cellular debris (Vernon, et al., 2002).

The up side of this immune system response is that it helps fight infection and cleans up debris. But the down side is that it sets off the release of cytokines - a group of immune system messenger molecules that exert a malign influence on the activities of nerve cells.

3.3. Free Radicals Attack Nerve Cells

Another consequence of the immune system's entry into the CNS is that inflammation accelerates the production of highly reactive forms of oxygen molecules called free radicals (Weeks, 1992).

Free radicals are produced as a by-product of normal cell metabolism. In the healthy spinal cord their numbers are small enough that they cause no harm. But injury to the spinal cord, and the subsequent wave of inflammation that sweeps through spinal cord tissue, signals particular cells to overproduce free radicals (Weeks, 1992).

Free radicals then attack and disable molecules that are crucial for cell function - for example, those found in cell membranes - by modifying their chemical structure. Free radicals can also change how cells respond to natural growth and survival factors, and turn these protective factors into agents of destruction (Weeks, 1992).

3.4. Nerve Cells Self-Destruct

Researchers used to think that the only way in which cells died during SCI was as a direct result of trauma. But recent findings have revealed that cells in the injured spinal cord also die from a kind of programmed cell death called apoptosis, often described as cellular suicide, which happens days or weeks after the injury (Vernon, et al., 2002).

Apoptosis is a normal cellular event that occurs in a variety of tissues and cellular systems. It helps the body get rid of old and unhealthy cells, by causing them to shrink and implode. Nearby scavenger cells then feed on the debris. Apoptosis seems to be regulated by specific molecules that have the ability to either start or stop the process (Vernon, et al., 2002).

For reasons that are still unclear, SCI sets off apoptosis, which kills oligodendrocytes in damaged areas of the spinal cord days to weeks after the injury. The death of oligodendrocytes is another blow to the damaged spinal cord, since these are the cells that form the myelin that wraps around axons and speeds the conduction of nerve impulses. Apoptosis strips myelin from intact axons in adjacent ascending and descending pathways, which further impairs the spinal cord's ability to communicate with the brain (Vernon, et al., 2002).

3.5. Secondary Damage Takes A Cumulative Tole

All of these mechanisms of secondary damage - restricted blood flow, excitotoxicity, inflammation, free radical release, and apoptosis - increase the area of damage in the injured spinal cord. Damaged axons become dysfunctional, either because they are stripped of their myelin or because they are disconnected from the brain. Glial cells cluster to form a scar, which creates a barrier to any axons that could potentially regenerate and reconnect (Vernon, et al., 2002). A few whole axons may remain, but not enough to convey any meaningful information to the brain (Kottke & Lehmann, 1990).

Researchers are especially interested in studying the mechanisms of this wave of secondary damage because finding ways to stop it could save axons and reduce disabilities. This could make a large difference in the potential for recovery.

4. CAUSES OF SPINAL CORD INJURY

Causes of SCI fall into two main categories: traumatic and non-traumatic. Most cases of SCI are traumatic. Major causes of SCI are listed in Table 1. Statistics from the USA and elsewhere indicate the most common traumatic causes are motor vehicle, motorbike, and pedestrian accidents, followed by falls (Robertson, 1992).

Table 1. Major causes of spinal cord injury as noted internationally.

Event	Annual Percentage
Motor Vehicle, Motorbike and Pedestrian accidents	51.1%
Falls	19.8%
Water Sport	13.0%
Crush Injury	5.3%
Violence	3.1%
Rugby	2.5%
Other Sport	1.2%
Horse Riding	0.6%
Other Trauma	3.4%

Reports from hospitals and rehabilitation clinics would suggest that the causes of SCI in South Africa are similar to the above (R. Campbell, personal communication, August 24, 2003) - although the level of political violence and violent crime are adding to the statistics in South Africa (Van der Spuy, 1996). Non-traumatic causes of SCI are much less common, and include viruses, viral infections, cysts and tumours (Kottke & Lehmann, 1990).

5. THE EFFECTS OF SPINAL CORD INJURY ON THE REST OF THE BODY

People who survive a SCI will most likely have medical complications, such as chronic pain and bladder and bowel dysfunction, along with an increased susceptibility to respiratory and heart problems (Kottke & Lehmann, 1990). Successful recovery at present depends upon how well these chronic conditions are handled day to day.

5.1. Breathing

Any injury to the spinal cord at or above the C3, C4, and C5 segments, which supply the phrenic nerves leading to the diaphragm, can stop breathing (Roth, Nussbaum & Berkowitz, 1995). People with these injuries need immediate ventilatory support. When injuries are at the C5 level and below, diaphragm function is preserved, but breathing tends to be rapid and shallow and people have trouble coughing and clearing secretions from the lungs because of weak thoracic muscles. Once pulmonary function improves, a percentage of those with C4 injuries can be weaned from mechanical ventilation in the weeks following the injury (Roth, Nussbaum & Berkowitz, 1995).

5.2. Pneumonia

Respiratory complications, primarily as a result of pneumonia, are a leading cause of death in people with SCI (Roth, Nussbaum & Berkowitz, 1995). In fact, intubation (mechanically supported ventilation) increases the risk of developing ventilator-associated pneumonia by one to three percent per day of intubation (Roth, Nussbaum & Berkowitz, 1995). More than a quarter of the deaths caused by SCI are the result of ventilator-associated pneumonia. SCI patients who are intubated have to be carefully monitored for this and treated with antibiotics if symptoms appear.

5.3. Irregular Heart Beat And Low Blood Pressure

SCIs in the cervical region are often accompanied by blood pressure instability and heart arrhythmias (Morgan, Silver & Williams, 1986). Because of interruptions to the cardiac accelerator nerves, the heart can beat at a dangerously slow pace, or it can pound rapidly and irregularly. Arrhythmias usually appear in the first two weeks after injury and are more common and severe in the most serious injuries (Morgan, Silver & Williams, 1986).

Low blood pressure also often occurs due to loss of tone in blood vessels, which widen and cause blood to pool in the small arteries far away from the heart (Roth, Nussbaum & Berkowitz, 1995).

5.4. Blood Clots

People with SCI's are at triple the usual risk for blood clots. The risk for clots is high in the first 72 hours, but afterwards anticoagulation drug therapy can be used as a preventive measure (Turpie, 1986).

5.5. Spasm

Many reflex movements are controlled by the spinal cord but regulated by the brain. When the spinal cord is damaged, information from the brain can no longer regulate reflex activity. Reflexes may become exaggerated over time, causing spasticity (Young & Shahani, 1986). If spasms become severe enough, they may require medical treatment.

5.6. Autonomic Dysreflexia

Autonomic dysreflexia is a life-threatening reflex action that primarily affects those with injuries to the neck or upper back (Bloch, 1986). It happens when there is an irritation, pain, or stimulus to the nervous system below the level of injury. The irritated area tries to send a signal to the brain, but since the signal is not able to get through, a reflex action occurs without the brain's regulation (Bloch, 1986). Unlike spasms that affect muscles, autonomic dysreflexia affects vascular and organ systems controlled by the sympathetic nervous system.

Anything that causes pain or irritation can set off autonomic dysreflexia: the urge to urinate or defecate, pressure sores, cuts, burns, bruises, sunburn, pressure of any kind on the body, ingrown toenails, or tight clothing (Bloch, 1986). For example, the impulse to urinate can set off high blood pressure or rapid heart beat that, if uncontrolled, can cause stroke, seizures, or death. Symptoms such as flushing or sweating, a pounding headache, anxiety, sudden high blood pressure, vision changes, or goose bumps on the arms and legs can signal the onset of autonomic dysreflexia (Bloch, 1986).

5.7. Pressure Sores

Pressure sores (pressure ulcers) are areas of skin tissue that have broken down because of continuous pressure on the skin. People with paraplegia and quadriplegia are susceptible to pressure sores because they cannot move easily on their own (Garber, Rintala & Hart, 2000). Places that support weight when someone is seated or recumbent are vulnerable areas. When these areas press against a surface for a long period of time, the skin compresses and reduces the flow of blood to the area. When the blood supply is blocked for too long, the skin will begin to break down (Garber, et, al., 2000). Since SCI reduces or eliminates sensation below the level of injury, people may not be aware of the normal signals to change position, and must be shifted periodically by a caregiver.

5.8. Pain After Spinal Cord Injury

Acute pain is common after a SCI. The pain may occur as a result of the damage to the spinal cord, or it may occur from damage to other areas of the body at the time of injury (Tunks, 1986). It is also common for many individuals with SCI to experience chronic pain. It can occur in areas where there is normal sensation, and it can occur in parts of the body where there is little or no feeling after injury. The pain is very real and may have a great impact on daily living (Tunks, 1986).

Research has shown that spinal cord injured persons' level of injury and how they are injured can have an impact on whether they have pain (Tunks, 1986). Individuals with low levels of injury tend to have more pain than those with higher levels of injury.

5.8.1. Groups of Pain

Individuals with SCI can experience several types of pain. The most common types can be classified into three groups.

5.8.1.1. Neuropathic Pain

Neuropathic pain is caused by damage or dysfunction in the nervous system, which includes the spinal cord. It can generally be described as a sharp, shooting, or burning pain (Kingery, 1997).

- *Spinal cord injury (central)* pain is a type of pain that can begin within weeks or months after the injury. Individuals feel this type of pain at or below the level of injury in areas where they have lost some or all sensation to touch (Kingery, 1997; Tunks, 1986). It is thought that the pain signals are coming from somewhere other than where the pain is felt. However, central pain is not related to what the individual does or how they are positioned. Additional terms used to describe central pain include tingling, numbness or throbbing (Kingery, 1997; Tunks, 1986).

- *Segmental* pain often occurs around the border where normal sensation occurs. It can be slightly above or below the level of injury and it usually develops during the first few months after injury. Segmental pain is often associated with allodynia and hyperalgesia in the painful region. Allodynia is pain caused by something that does not normally cause pain, for example, something cold, warm or a very light touch to the skin can result in pain. Hyperalgesia means an extremely painful response to what is normally only mildly painful (Kingery, 1997; Tunks, 1986).
- *Nerve root entrapment* pain often begins days to weeks after injury and may worsen over time. It occurs at or just below the level of injury and has a distinct pattern. The individual may feel brief waves of stabbing or sharp pain or a band of burning pain at the point where normal feeling stops. He/she may find that light touch makes the pain worse. The pain stems from compression of a nerve root by a bone or disk. Pain from damage to the cauda equina (the lower part of the spinal column) is a type of nerve root pain that is described as a burning feeling in the legs, feet, pelvis, genitals, and rectum (Kingery, 1997; Tunks, 1986).
- *Syringomyelia* is a hollow, fluid-filled cavity (syrinx) in the spinal cord. It is not common, but sometimes develops months or years after injury. The cavity can slowly increase in size and extend up or down the spinal cord. As the syrinx expands, it can result in pain along with an increased loss of sensory and motor function (Kingery, 1997; Tunks, 1986).

5.8.1.2. Musculoskeletal

This type of pain is also a concern for individuals with SCI. It occurs in parts of the body, like the bones, joints, and muscles. Musculoskeletal pain is usually worsened by movement and eased with rest. It can generally be described as a dull or aching pain (Tunks, 1986).

- *Secondary overuse (pressure syndromes)* is a very common cause of musculoskeletal pain. The pain can occur months or many years after injury. It is caused by the overuse of muscles in any part of the body. For example, many people develop tendonitis of the rotator cuff (shoulder) as a result of pushing a manual wheelchair for a long period of time (Tunks, 1986).
- *Muscle spasm* pain is experienced by some individuals after SCI. The spasms are involuntary movements of the body in areas that have lost some or all motor function. The pain is caused when muscles and joints are strained (Tunks, 1986).
- *Mechanical instability of the spine* is caused by damaged ligaments or fracture of bones. It occurs most often shortly after injury, but it can also develop later. The pain is usually around the area of instability (Tunks, 1986).

5.8.1.3. Visceral

Visceral pain usually begins a short time following SCI. It occurs in the abdomen either above or below the level of injury. The pain is described as burning, cramping and constant (Tunks, 1986).

5.9. Bladder And Bowel Problems

Most SCIs affect bladder and bowel functions because the nerves that control the involved organs originate in the segments near the lower termination of the spinal cord and are cut off from brain input (Seaton & Hollingworth, 1986). Without coordination from the brain, the muscles of the bladder and urethra cannot work together effectively, and urination becomes abnormal. The bladder can empty suddenly without warning, or become over-full without releasing. In some cases the bladder releases, but urine backs up into the kidneys because it is not able to get past the urethral sphincter. Most people with SCIs use either intermittent catheterisation or an indwelling catheter to empty their bladders (Seaton & Hollingworth, 1986).

Bowel function is similarly affected. The anal sphincter muscle can remain tight, so that bowel movements happen on a reflex basis whenever the bowel is full (Seaton & Hollingworth, 1986). The muscle can also be permanently relaxed, which is called a "flaccid bowel," and results in an inability to have a bowel movement. This requires more frequent attempts to empty the bowel and manual removal of stool to prevent faecal impaction. People with SCIs are usually put on a regularly scheduled bowel program to prevent accidents (Seaton & Hollingworth, 1986).

5.10. Reproduction And Sexual Function

5.10.1. Women

SCI has a greater impact on sexual and reproductive function in men than it does in women. Most spinal cord injured women remain fertile and can conceive and bear children. In fact, regular menstrual periods and the ability to become pregnant most often occur between three to nine months following SCI for women (Wesgren & Levi, 1998).

However, these women often worry about bowel and bladder incontinence, spacticity, dysreflexia, pain with sensitive sensations due to touch, physical response, mental response, embarrassment, and a lack of mutual pleasure with a partner during sexual intercourse (Wesgren & Levi, 1998). Other feelings that impact sexuality include a poor self-image, depression, and a fear of rejection.

Clearly, although physical reproductive aspects of female sexuality may not be severely impacted, emotional sexuality and spontaneity can be rigorously affected. Also, women with SCI may have a worsening of pressure sores, urinary incontinence, and constipation during pregnancy. Those with high lesions may also have more breathing difficulties due to pressure from the enlarged uterus (Wesgren and Levi, 1998).

5.10.2. Men

Men on the other hand may be directly affected in terms of sexual function by a SCI. Depending on the level of injury, men may have problems with erections and ejaculation, and most will have compromised fertility due to decreased motility of their sperm. Treatments for men include vibratory or electrical stimulation and drugs such as Sildenafil (Viagra). Many couples may also need assisted fertility treatments to allow a spinal cord injured man to father children (Wesgren and Levi, 1998).

6. AVAILABLE AND DEVELOPING TREATMENT

6.1. Rehabilitation

Within the context of the health services environment, medical rehabilitation seeks to enhance the residual functional abilities of people who have acquired a disabling impairment that has limited their ability to function independently (Hall, et al., 1994). The ultimate goal is to enable individuals to live in the least restrictive, least costly environment at their highest possible level of independence.

The trademark of rehabilitation in SCI is its strong commitment to an interdisciplinary team approach that attempts to address the full scope of the individual's physical, emotional and other support needs (W. Gibb, personal communication, August 24, 2003). In the initial phase of rehabilitation, therapists emphasize regaining leg and arm strength since mobility and communication are the two most important areas of function. For some, mobility will only be possible with the assistance of devices such as a walker, leg braces, or a wheelchair (Hall, et al., 1994). Communication skills, such as writing, typing, and using the telephone, may also require adaptive devices.

In later phases, physical therapy includes exercise programs geared toward muscle strengthening. Occupational therapy helps redevelop fine motor skills. Bladder and bowel management programs teach basic toileting routines, and patients also learn techniques for self-grooming. People also acquire coping strategies for recurring episodes of spasticity, autonomic dysreflexia, and neurogenic pain (Chin, Finnocchiaro, & Rosebrough, 1998; Hall, et al., 1994).

It is apparent from the above description that rehabilitation is intensive and most often long term, involving constant attention and care. For the majority of South Africans, this is simply beyond financial reach and disability payment from employers and government is often inadequate to satisfy the individual's financial and family responsibilities. Medical expenses involved in surgical and biological treatment are also often unaffordable. In the mean time, however, researchers are attempting to discover new ways of treating and preventing the severe extent of these injuries.

6.2. Spinal Cord Research

The last three decades has seen an advance in spinal cord medicine and an unprecedented increase in the forms of treatments available to patients with SCI.

While basic scientists strive to develop strategies to restore neurological connections between the brain and body of spinal cord injured persons; bioengineers are working to restore functional connections via advanced computer modelling systems and neural prostheses. A functional electrical stimulation system is one example of this kind of innovative research. Functional electrical stimulation systems use electrical stimulators to control muscles of the legs and arms to encourage functional walking and to stimulate reaching and gripping (Peckham, 1997). Electrodes are taped to the skin over nerves or surgically implanted and then controlled by a computer system under the command of the user. For example, to assist reaching, electrodes can be placed in the shoulder and upper arm and controlled by movements of the opposite shoulder. Through a computer interface, the spinal cord injured person can then trigger hand and arm movements in one arm by shrugging the opposite shoulder (Peckham, 1997).

Another area of research is focusing on central pattern generators. Current research is showing that these neurons can be retrained after SCI to restore limited mobility to the legs. Using a technique called sensory patterned feedback, researchers are attempting to retrain central pattern generator networks in spinal cord injured patients with special programs that break down walking movements into their component patterns and force paralysed limbs to repeat them over and over again (Kandel, Schwartz, & Jessel, 1991).

Other areas of research are focussing on relieving pressure created by injury on the spinal cord through surgery, and several pain medications and surgical procedures are also being researched to aid with the control of acute and chronic pain (Gersh, 1992; Kingery, 1997).

But can an injured spinal cord be rebuilt? This is the question that drives basic research in the field of SCI. As investigators try to understand the underlying biological mechanisms that either inhibit or promote new growth in the spinal cord, they are making surprising discoveries, not just about how neurons and their axons grow in the CNS, but also about why they fail to regenerate after injury in the adult CNS. Understanding the cellular and molecular mechanisms involved in both the working and the damaged spinal cord could point the way to therapies that might prevent secondary damage, encourage axons to grow past injured areas, and reconnect vital neural circuits within the spinal cord and CNS (Borgens, 2001).

Researchers are focused on advancing our understanding of the four key principles of spinal cord repair (Borgens, 2001):

- Protecting surviving nerve cells from further damage
- Replacing damaged nerve cells
- Stimulating the re-growth of axons and targeting their connections appropriately
- Retraining neural circuits to restore body functions

From the above description, it is apparent that researchers are more focused on regaining functional ability than on reducing the secondary medical complications associated with SCI. Although the ability to walk again is probably an injured persons most desired treatment outcome, many psychologists and family members would agree that an improved quality of life while disabled would also be beneficial. Finding new ways to eliminate or to at least reduce these complications may be important when considering the holistic nature of the spinal cord injured individual.

But it does become clear that these individuals do suffer a wide variety of health problems and disabilities and it takes time to build enough strength to be able to fully participate in daily activities again. Added to this, an individual needs to adjust to the disability on an emotional level as well. Depression can have even further devastating effects of the individual with SCI.

7. THE PSYCHOLOGICAL IMPACT OF SPINAL CORD INJURY

7.1. Depression And Its Treatments

According to Tate, Forchheimer, and Maynard (1994), mood disturbances are common among individuals with chronic health conditions, such as SCI. More often than not, according to these researchers, these experiences are described by the word ‘depression’. Depression can be defined in a number of ways. It is defined here using the diagnostic criteria established in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association, 1994), as well as the International Classifications of Impairments, Disabilities and Handicaps published in 1989 by the World Health Organisation (Tate, Forchheimer, & Maynard, 1994).

These texts state that depression is not a single entity, but rather a spectrum of depressive disorders. The specific constellation of symptoms determines whether an individual meets the criteria for a specific depressive disorder, and the origin of symptoms further dictates which depressive disorder is diagnostically appropriate for a specific individual (American Psychiatric Association, 1994; Tate, Forchheimer, & Maynard, 1994).

Depression can have devastating effects on an individual with SCI, and it can be a major factor in the higher utilisation of health services (Trieschmann, 1997).

Furthermore, it has been associated with sub-optimal functional gains, increased complications such as pressure ulcers and urinary tract infections, increased chronic and acute pain, compromised immune function, increased hospital stays, increased medical expenses, decreased social integration, compromised intimate relationships, and strained care-giver support (Trieschmann, 1997). The co-morbidity of depression and SCI can prove lethal.

A SCI changes an individual's life profoundly and generates a period of enforced helplessness post-injury, followed by a gradual resumption of limited independence (Elliot & Frank, 1990). In a study of 30 individuals with SCI, depression was the most frequent post-injury diagnosis, usually appearing within the first month (Tate, Forchheimer, & Maynard, 1994). A greater frequency of depression was noted in those with complete injuries, possibly, according to the researchers, because those with incomplete injuries maintained more hope regarding rehabilitation and were, as a result, less depressed.

According to Barlow and Durand (1999), psychological treatment of depression in patients with SCI can assist the depressed individual in several ways. First, supportive counselling helps ease the pain of loss of many abilities and functions, and addresses the feelings of hopelessness that accompany the depression. Second, cognitive therapy changes the pessimistic ideas, unrealistic expectations, and overly critical self-evaluations that create depression in this population and sustain it. Cognitive therapy helps him/her to develop positive life goals, and a more positive self-assessment. Behavioural therapy may be used to develop better coping skills, and interpersonal therapy can be used to assist in solving relationship problems (due to anger, frustration and decreased sexual functioning to name a few) after this traumatic time (Barlow & Durand, 1999).

Hopelessness is a central feature of depression, along with helplessness. According to Hafen, et al. (1996), if one views one's world as bad, filled with problems and without an idea that you may be able to do anything about them, you generally feel helpless. If you do not believe your life will improve and if you think that the future is bleak, then you will begin to feel hopeless. Pessimism encourages these negative assessments of one's life. Optimism on the other hand, appears to create some protection from depression and prevents an individual from reaching those conclusions (Hafen, et al., 1996). In fact, researchers have studied the use and role of optimism in the vulnerability and treatment of depression quite extensively.

Taylor, et al. (1992) examined a group of students making the adjustment to their first semester of college – an often difficult and stressful time. Optimism, self-esteem and a number of other variables were assessed when the students first arrived on campus. Measures of psychological and physical well-being were obtained at the end of the semester. Higher levels of optimism upon entering college predicted lower levels of psychological distress at the end of the semester. The relationship was independent of effects due to self-esteem, locus of control, desire for control and baseline mood.

In another study involving first year law students, Segerstrom, et al. (1998) assessed dispositional optimism and mood disturbance prior to the beginning of classes. The same measures were re-administered at mid-semester approximately eight weeks later. Baseline optimism was associated with fewer mood disturbances at follow up, and this relation remained significant even after controlling for initial level of mood disturbance.

In a study involving a middle-aged sample, Bromberger and Matthews (1996) focused on women approaching menopause. Optimism, depressive symptoms and life stress were assessed at baseline and again three years later. Women with a more pessimistic orientation at baseline were at higher risk for symptoms of depression at follow-up, with the reverse being true for those who had a more optimistic worldview.

Optimism has been linked with lower rates of depression in school-aged children (Yates, et al., 1984), and Seligman (1991) found in an elderly population that increased personal freedom, which increased optimism, was also linked to a decrease in depression and increased lifespan.

In fact, optimism has even been shown to improve many of the somatic complaints associated with depression. In a study conducted by Segerstrom, et al. (1998), results indicated that increases in optimism were associated with improved immune functioning and, therefore, decreased use of medication.

According to Scheier et al. (1994), optimism is one of the most effective mechanisms in the reduction of depression and its various effects on an individual, and has been repeatedly linked to both psychological and physical well-being. Building on initial studies, researchers are discovering that the power of optimism may not only be beneficial for the mind, but for the body as well. However, before I examine this connection more fully, a detailed explanation of optimism is elucidated.

8. WHAT IS OPTIMISM?

Commonly defined, optimism reflects an expectation that good things will happen, whereas pessimism reflects an expectation that bad things will happen (Scheier, Carver, & Bridges, 1994). Hence, although likely to be interrelated, optimism should be distinguished from other notable psychological variables such as internal locus of control and self-esteem. Likewise, pessimism should not be confused with expressions of lack of control and self-effacement (Scheier, Carver & Bridges, 1994).

When people confront adversity or difficulty in their lives, they experience a variety of emotions, ranging from excitement and eagerness, to anger, anxiety and depression. The balance among these feelings appears to relate to people's degree of optimism and pessimism (Taylor, et al., 1992). Optimists are people who expect to have positive outcomes, even when things are difficult. This confidence should yield a mix of feelings that is relatively positive. Pessimists expect negative outcomes which should yield a greater tendency toward negative feelings – anxiety, guilt, depression, anger, and sadness (Taylor, et al., 1992).

One of the most popular measures used to assess for optimism and pessimism has been Scheier and Carver’s (1985) Life Orientation Test (LOT). The LOT is a 12-item measure which consists of 4 positively worded items, 4 negatively worded items, and 4 filler items. Although the LOT is typically considered a unidimensional measure of dispositional optimism, some studies have found that it has a bidimensional structure (Smith, Pope, Rhodewalt & Poulton, 1989).

In 1994, Scheier et al. introduced a briefer version of the LOT, the revised Life Orientation Test (LOT-R), a 10 item (3 positive items, 3 negative items and 4 filler items) measure of dispositional optimism. The LOT-R essentially eliminated some of the content overlap with coping that existed in the original LOT. Also similar to the LOT, the LOT-R is generally considered a uni-dimensional measure of dispositional optimism, and these measures provide the most direct assessment of optimism and pessimism as we commonly understand them.

According to Aspinwall, Richter and Hoffman (2002), optimists are distinguishable from pessimists in that optimists are more flexible and adaptive in their consideration of information about potential problems and stressors. They suggest that optimism reliably predicts increased, rather than decreased, attention to negative information, if that information is useful or relevant to the self in some way. Attention to negative information is a critical first step in coping, problem-solving, preventive health behaviour, self-improvement, and a host of other self-regulatory behaviours (Aspinwall et al., 2002). In such domains as education, health, work, and interpersonal relations, careful processing of information about the self and the environment, especially negative information, is essential to obtaining feedback about one's progress towards goals, to formulating appropriate performance standards, and to evaluating behavioural alternatives (Aspinwall et al., 2002). Therefore, any state or belief that contributes to the ability to process such information is likely to have enormous benefits.

The ability of people with positive beliefs to pay more attention to negative information may also account for the more successful moderation of behaviour, belief and processing effort. That is, to determine whether a problem is worth addressing with active coping methods or whether it is something one must accept or disengage from. According to Aspinwall et al. (2002), one must be able to attend to the problem closely and to process even unflattering, threatening, or discouraging information in an unbiased manner. Processing of such information is likely to assist optimists in developing solutions that correspond well to the objective features of stressors and problems and to assist them in modifying their efforts accordingly.

Scheier, Carver and Bridges (2002) commented that it is particularly noteworthy that optimists also turn toward acceptance in uncontrollable situations, whereas pessimists tend to turn toward the use of overt denial. Although both tactics seem to reflect emotion-focused coping, there are important qualitative differences between them that may, in turn, be associated with different qualities of outcome. More concretely, denial means attempting to adhere to a worldview that is no longer valid. In contrast, acceptance implies a restructuring of one's experience so as to come to grips with the reality of the situation, such as SCI that one confronts (Scheier et al., 2002). Acceptance thus may involve a deeper set of processes, in which the person actively works through the experience, attempting to integrate it into an evolving worldview. The active attempt to come to terms with the existence of problems may confer special benefits to acceptance as a coping response. It may cause people to reprioritise their lives, to realistically revise long-term goals and to use what time they have in constructive and optimal ways (Scheier et al., 2002).

Throughout the rest of this paper I, therefore, use the term "optimist" to denote those research participants whose scores on a standardised measure of optimism, e.g. the LOT, are one standard deviation or more above the mean in their respective samples.

The related concept of hope has also enjoyed appeal and has also been linked to improved physical and psychological well-being. Hope – defined as "a wealth of optimism", is a pragmatic, goal-orientated attitude which combines goal-directed determination with the ability to generate the means of reaching these goals (agency) (Snyder, Sympsom, Michael & Cheavens, 2002).

Hope has been related to psychological adjustment in several ways. Research has shown that there is a positive correlation between hope and belief in ones capabilities, as well as between hope and feelings of self-worth (Snyder et al., 2002).

In one study, hope was positively correlated with children's perceptions of scholastic competence, social acceptance, athletic ability, and physical appearance (Curry, Snyder, Cook, Ruby, & Rehm, 1997). Hopeful thinking has also been associated with an increased feeling of self-worth in both children (Snyder, et al., 2002) and adults (Snyder, Wiklund, & Cheavens, 1999). Further, higher hope is associated with lower levels of depression in children (Snyder et al., 2002).

Research also supported the contention that hope is positively related to problem-solving, and in a study conducted by Barnum, Snyder, Rapoff, Mani, & Thompson (1998), higher hope levels in adolescent burn survivors correlated with engaging in fewer behaviours that would undermine recovery. These burn survivors also had a greater number of successful interactions with others, and a higher level of global self-worth.

Hope also appears to play a role in coping with potentially life-threatening diseases. In a study conducted by Irving, Snyder and Crowson (1998), college women scoring high on hope levels demonstrated greater knowledge about cancer and increased hope-specific coping responses to an imagined task of coping with cancer than did college women scoring low on hope levels, even when controlling for academic achievement, experience with cancer (in family and friends), and negative affectivity. Thus, hope may facilitate adjustment across the various stages of coping with illnesses.

The first instruments developed to measure hope were based on Scotland's narrow conceptualisation of hope as an expectation of good achievement (Herth, 1992). The completion of qualitative studies exploring dimensions of hope during the 1970s and early 1980s in well and chronically ill adult populations described additional elements common to the experience of hope and laid the foundation for the development of the first multidimensional measures of hope. Specific dimensions of hope identified in these studies were the interpersonal element; the time-oriented, future focus of hope; and the goal-achievement expectation of hope. The Hope Index Scale (Obayuwana et al, 1982), the Stoner (1988) Hope Scale, the Miller Hope Scale (Miller & Powers, 1988) and the Nowotny (1998) Hope Scales addressed these multiple dimensions of hope.

Studies completed since the mid-1980s (Dufault & Martocchio 1985; Hinds & Martin 1988) with the ill and the elderly population suggested, however, that in addition to the multidimensional elements of hope identified earlier, a number of conceptual issues still needed to be addressed. Concepts that were not included in the existing hope instruments included: (a) a more global, non-time oriented sense of hope; (b) hope despite diminished or absent interpersonal relationships; (c) hope as a sense of being available and engaging in relationships, as opposed to doing for oneself and others; and (d) potential of hope for controlling behavioural or emotional responses as opposed to the control of events or experiences.

The Herth (1991) Hope Scale was designed to incorporate, not only the critical elements incorporated in the other scales, but also these more recently identified concepts. Thus Herth's scale, because of its broader conceptual basis, has increased potential for use in clinical situations with ill and elderly populations.

Research thus clearly indicated that the influence of hope and optimism on the individual may be extremely beneficial. Scheier, Magovern, Abbott, Owens, Lefebvre and Carver (1989) wrote that this is even more so since optimism has been implicated as a mechanism for recovery in physical and medical conditions as well.

8.1. Optimism And Its Role In Physical Recovery

People characterised as dispositional optimists have been shown to display superior psychosocial adaptation to a host of medical stressors, including coronary artery bypass surgery, childbirth, failed *in vitro* fertilisation, bone marrow transplantation, arthritis, tinnitus and hearing impairment, HIV-positive status, pregnancy termination, and cancer (Affleck et al., 2002).

Scheier, et al. (1989) examined the effect of dispositional optimism on recovery from bypass surgery in a group of 51 middle-aged men. Dispositional optimism proved to be an important predictor of coping efforts and surgical outcomes. More specifically, dispositional optimism (as assessed prior to surgery) correlated positively with manifestations of problem-focused coping and negatively with the use of denial. Dispositional optimism was also associated with a faster rate of physical recovery during the period of hospitalisation and with a faster rate of return to normal life activities subsequent to discharge. Finally, there was a strong positive association between level of optimism and quality of life at six months post-surgical. In another study, Scheier, et al. (1999) also found that more optimistic bypass surgery patients had a far lower rate of rehospitalisation with secondary complaints post-surgery.

Affleck et al. (2002) studied 75 patients with rheumatoid arthritis, a chronic and painful disease. Optimists reported more positive daily mood, less pain-related activity limitations, less negative daily events and better sleep than the pessimists in the group. In a second study, these researchers also investigated the effects of optimism on patients with asthma and women with primary fibromyalgia syndrome. Optimists in both groups reported less pain/asthma and, therefore, less use of pain relieving medication, less attention to pain/asthma, a more pleasant mood, better personal control of pain/asthma, and better coping strategies in contending with pain/asthma (Affleck et al., 2002). The same researchers also showed that symptom expectancies in the abovementioned patients predicted next-day symptoms. According to these researchers, optimists were more likely to believe that 'tomorrow would be a better day' and also that they would be able to cope with the variety of symptoms better the following day.

9. HOW DOES OPTIMISM WORK TO IMPROVE OR MAINTAIN GOOD HEALTH?

Research suggests that there are two main differences between optimists and pessimists that have an impact on their general physical health, namely those involving psychobiology and cognitions.

Kamen-Siegel, Rodin, Seligman and Dwyer (1991) showed that optimism is positively correlated with the vigour with which the immune system responds to an antigen challenge. Peterson and Bossio (2002) described how pessimism is associated with lowered immune function in persons with HIV/AIDS.

One of the reasons pessimism can contribute to illness, even infectious disease, is that it may, over time, indeed disrupt the immune system. According to Rossi (1986), when we experience strong emotions related to pessimism, the internal organs respond by preparing to flee or strike out (the classic “flight or fight response” characteristic of stress). Glandular activity sends hormones coursing through the bloodstream, which in turn send messages back to the nervous system. Sometimes immediately, but more often gradually, these messages wear down components of the immune system (Rossi, 1986).

Various studies have shown the connection between the CNS and the immune system, a connection that allows the mind to influence either susceptibility or resistance to disease. For example, the thymus gland, which is part of the hypothalamic-limbic system (which has been identified as being the mediator between emotions and the biological functioning of the human being), plays an essential role in the maturation of immune system cells (Rossi, 1986). Researchers have discovered extensive networks of nerve endings laced throughout the thymus gland, and rich supplies of nerve also serve the spleen, bone marrow, and lymph nodes, giving further evidence links between the brain and the immune system (Rossi, 1986).

Furthermore, the cells of the immune system seem to be equipped to respond to chemical signals from the CNS (Rossi, 1986). For example, the surface of the lymphocytes has been found to contain receptors for a variety of CNS chemical messengers, such as catecholamines, prostaglandins, serotonin, endorphins, sex hormones, thyroid hormone and growth hormone.

Because of these receptors on the lymphocytes, physical and psychological stress alter the immune system. Stress, anxiety and depression cause the body to release several powerful neurohormones, including catecholamines, corticosteroids, and endorphins, which bind with the receptors on the lymphocytes and alter immune function (Rossi, 1986). Corticosteroids, in fact, have been found to have such a powerful influence in suppressing the immune system that they are widely used to treat allergic conditions (such as asthma and hay fever) and autoimmune disorders (such as rheumatoid arthritis and rejection of transplanted organs).
According to research, different parts of the brain where emotions related to both optimism and pessimism originate, are also associated with specific hormone

patterns (Rossi, 1986). The release of certain hormones, then, is associated with different emotional responses, and those hormones affect health. We know, for example, that emotionally induced shifts in hormones can lead, over time, to chronic disease, such as high blood pressure. When a person is aggressive and anxious (emotions which are related aspects of pessimism), for example, too much norepinephrine and epinephrine are secreted, even at rest. As time goes by, the arteries thicken, and the excess hormones cause blood vessel muscles to constrict. The gradual rise in blood pressure can then result in hypertension, stroke or even heart failure.

Optimism and pessimism are important cognitive traits in many disorders, but are particularly salient symptoms in the mood disorders (Zuckerman, 2002). In patients with bipolar disorder, the short-term unrealistic optimism of the grandiose and impulsive manic episode can be transformed within days or hours to the pessimism and hopelessness of the depressive phase . Changes in the biochemistry during such mood shifts illustrate how the central neurochemical balances may affect mood, cognition and indeed optimism or pessimism (Zuckerman, 2002).

According to Affleck et al. (2002), optimists exhibit diminished cardiovascular reactivity to stress, as opposed to pessimists, and this too may function as a form of protection from many heart and cardiovascular diseases. There are also cognitive mechanisms involved in the positive physical outcomes of optimism.

One possibility, according to Taylor, et al. (1992), why optimists do better than pessimists, is because they cope more effectively. Optimists and pessimists differ from one another in reports of their general coping tendencies and in the coping responses they bring to mind when considering hypothetical situations (Scheier et al., 1986), recalling a stressful situation from the recent past (Scheier et al., 1986), dealing with infertility problems (Litt, Tennen, Affleck, & Klock, 1992), managing a life transition (Taylor, et al., 1992), coping with a serious disease (Friedman, et al., 1992) and dealing with worries about specific health threats (Stanton & Snider, 1993).

Carver, et al. (1993) studied how specific coping responses mediated the effect of optimism on distress in a study of 59 women with breast cancer. Three coping responses were notable for their positive effects in this study. Acceptance was consistently linked to low levels of concurrent distress and was a prospective predictor of low distress at post-surgery. The use of humour was linked to low concurrent distress at post-surgery and was a prospective predictor of low distress at the six-month follow-up. Positive reframing was related to low concurrent distress at all assessments. Related research suggested that these differences in outcomes derive partly from differences between optimists and pessimists in the manner in which they cope with the challenges in their lives.

A general characterisation of the findings of this research is that optimists tend to use more problem-focused coping strategies than do pessimists. When problem-focused coping is not a possibility, optimists turn to more adaptive emotion-focused coping strategies such as acceptance, use of humour, and positive reframing of the situation.

Peterson and de Avila (1995) also found that an optimistic explanatory style is associated with the belief that good health can be controlled (i.e., maintained and promoted). Optimists tend to believe that they can not only control their health, but their symptoms as well, and this leads to a stricter adherence to medication and other health advice. This belief has proved to have an extraordinary effect, not only on these individuals' quality of life while ill, but also on their rate of recovery. Also because optimists believe that they have control over their illness and that they will one day be healthy again, they participate in less risky health behaviour such as substance abuse and overexertion.

10. IMPLICATIONS FOR TREATMENT AND RECOVERY OF SECONDARY MEDICAL COMPLICATIONS OF PERSONS WITH SPINAL CORD INJURY

It has been found that, due to the severe, traumatic and life-altering effects of SCI on an individual, the vast majority of these patients develop signs of depression within the first month post-injury, with many developing them within the first two weeks. Among other things, depression has also been demonstrated to increase secondary medical complications, such as pressure ulcers, urinary tract infections, increased chronic and acute pain, and compromised immune function in this population. The connection between depression and such physiological mechanisms as immune functioning, has been demonstrated biologically and research into other chronically ill populations has proffered similar results. Thus a clear mind-body connection between the emotional aspect of depression and physiological aspects of health has been established. Further, a lowering of the effective functioning of the immune system has been determined to be the primary cause of a vast array of medical disorders, including those associated with SCI. The connection between depression and a decrease in effectiveness of the immune system could be used to plan the treatment of these individuals.

Two of the key features of depression, namely helplessness and hopelessness, have attracted much attention within the realm of psychology and have been extensively linked to the similar features of the personality dimension of pessimism. Pessimism and optimism have also been extensively researched and the effects of these two traits have been studied in a variety of behavioural, cognitive and health related situations in study samples.

Optimism has been demonstrated on its own to be related to improved physical functioning and increased well-being, both psychologically and physically. Optimism has also been linked to decreases in depression and the somatic effects that it has on the human body. Indeed, increased levels of optimism decrease existing levels of depression and even prevent depression in many individuals.

Among the several reasons why depression has such a negative impact on the body, say researchers, is that hopelessness (or pessimism about the future) leads to change in proactive and problem-solving behaviour. Patients start to ignore medical advice from physicians and family, and stop many self-care regimes. Without a future-orientated focus, much of the integral wellness practices followed by these individuals become defunct, and they also often begin to partake in dangerous and unhealthy behaviours. Substance abuse may increase with the increase in pain, healthy eating patterns are disrupted, sleep as an energy and health providing tool, is disturbed, and decreased energy levels lead to an even greater decrease in goal-directed activity toward health care.

Optimists, on the other hand, have been shown to have far lower levels of depression and a more future-oriented focus. They participate in less risky activity and believe that they have the power to control their health and conquer the negative effects of a health condition such as pain. They are far more likely to stick to prescribed interventions and they are also more likely to be open to emotional support from physicians, family members and friends.

Optimists have also been shown to possess better coping mechanisms than pessimists when dealing with health complications and rely less on denial and more on acceptance when dealing with these problems. Optimists have also been shown to achieve higher standards in both everyday life and in physical recovery from disease, and have been considered to have a greater chance of complete recovery in most illnesses than pessimists.

It is for all of these reasons that SCI research should be focussing more on this personality trait as an agent for prevention and recovery from the secondary medical complications associated with this injury. Not only would increased levels of optimism reduce the rate of depression in this population, but the decrease would also reduce the severity of the associated medical complications, if not remove them entirely, thus improving the overall quality of life of the SCI patient. This too would have a tremendous impact on the financial burden associated with SCI for the individual, as well as the economy as a whole. Optimistic patients have proved to succeed to greater levels of recovery in all illnesses where this trait has been studied and negative complications such as pain which reduce quality of life in all affected individuals, is significantly reduced.

Most of the SCI specific secondary medical complications described above, including pressure ulcers, blood clots, pain, urinary tract infections, compromised immune function and cardiovascular complaints, have been found to be reduced in other medical samples where high levels of optimism was investigated high and it is the conviction of the present researcher that these complications would show similar improvement in the study population.

Depression and/or pessimism may even be linked to cellular apoptosis, or cell suicide, which to date has been a misnomer to researchers in the field. If one is to accept the abovementioned theory that the emotional correlates in the brain are linked through a variety of lymphocytes to the thymus gland and the hypothalamic-limbic system, then one may speculate that the onset of depression due to the trauma of the injury may in some way be related to this event. If researchers could prove these psychophysiological connections, the extent of post-injury destruction may even be reduced.

But are optimism and pessimism permanent or enduring traits within an individual? According to Seligman (1991) and Gillham, Reivich, Jaycox, and Seligman (1995) a negative explanatory cycle can be changed to positive. For example, Seligman found that he could increase the level of optimism in 25 elderly patients when they were given greater personal freedom over their lives. This not only decreased the levels of depression among this sample, but also increased the life expectancy of these individuals.

Seligman (1991) also taught learned optimism to 40 cancer patients and produced a very sharp increase of natural killer cells, showing once again not only the link between the immune system and emotional and personality aspects such as optimism, but also the psychophysiological benefits of a higher level of optimism.

Seligman has also begun a longitudinal intervention program that involves teaching grade school children to be more optimistic. Results to date suggest that optimism training makes subsequent episodes of depression less likely.

Finally, the cognitive features of learned optimism, as described by Seligman, are of interest. Cognitive therapy that targets negative ways of thinking and alleviates depression, by implication, could be an important future focus when working with optimism and pessimism in the spinal cord injured population, and may pay extraordinary health dividends as well.

From the above research it is clear that optimism does indeed have a beneficial impact on both psychological and physical well-being and that the two should be seen in a holistic manner when dealing with the effects and treatment of patients with SCI. The concept of optimism should provide new focus within this field and if optimism can be taught to this population the effects may be even more far reaching.

11. CONCLUSION

Disability can be likened to the proverbial iceberg: the onlooker can see only the tip, whereas the entity itself contains more hidden aspects of its being than are revealed on the surface. Inability to move body parts, an expression of physical pain or the absence of normal sense experiences, the lack of sensory input or motor output, a missing or dysfunctional limb or structure, and other such reflections of loss are just the surface structure of physical disability.

At best, our understanding of what an individual who is disabled might feel about the state he or she is in can only be an approximation of their unique perceptions or feelings. All of those uniquely combined thoughts and feelings that the individual has gathered during a lifetime of personal experiences shape that individual's perception of disablement. The factors that shape individual reactions include the set of values, directions, and prohibitions taken on by the individual (Moore, Bombardier, & Brown, 1994). These combine with innate and acquired drives, needs and experiences to create an individual perceptual mode and form an individualised cognitive base. It is through this cognitive base that the individual has learned to see the self and the surrounding world (Moore, et al., 1994). The resultant self-image, whether conscious or unconscious, organises the stage and creates a set of values and expectations by which one measures oneself and one's worth. It becomes the compass with which one steers through life and guides relationships, and the framework that structures the goals and foundations of one's individualised world (Schultz & Decker, 1985).

Through this process, a method of coping and functioning emerges – the style of coping through which one recognises the self (Moore, et al., 1994). Then suddenly the lifelong foundation and structure of that 'self' becomes damaged and weakened by the impact of the disability, oftentimes to the point of total collapse. The disabling condition, as well as the perception of it, disrupts the structure that had been so carefully erected over time. Rules and roles change, relative independence and the ability to perform the essential tasks of living are gone, or perceived as such. The ability to give or take love, care, affection, and support is diminished or lost. Existing relationships are distorted or destroyed. Relative financial stability and security may vaporise into thin air.

It is thus not surprising that the most common diagnosis within the very first month post-injury is depression. Hopelessness and helplessness go hand in hand as the person is thrown into a foreign existence and it is difficult to consider that the future may be better when life at this moment is so bleak. This state of emotional despair even adds to the existing burden by contributing its own set of confounding problems in health conditions.

The treatment of these individuals is thus far more complex than first meets the eye. The complex interplay of the psychological and the physical requires a unique approach and an alternative focus. Alternative approaches to medicine address the whole person: thoughts, feelings, and behaviours. They allow the person to exercise choice. They sustain hope. And they guide individuals through their own lives, in how and why their health can improve, while bearing in mind the frailty of the perceived self.

The role of optimism may thus be particularly beneficial in this regard. It has proven to be a successful ameliorative solution in a wide variety of psychological and medical complaints and has proved worthwhile as a suitable alternative in dealing with an individual as a whole across a variety of situations and circumstances.

The present study attempted to illustrate the connections that may inspire other researchers to examine this trait as a tool in the treatment and recovery of the secondary medical complications of persons with SCI. A furthering of our understanding of this concept and the biological connections that it displays in other chronically ill patients may be of most beneficial use and it is, therefore, considered as a priority for study.

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