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Examining the Nutritional Status and Nutrition Intake of Community Dwelling Non-Ambulatory Individuals with a Spinal Cord Injury With and Without Pressure Ulcers

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Examining the Nutritional Status and Nutrition Intake of Community Dwelling Non-Ambulatory Individuals with a Spinal Cord Injury With and Without Pressure Ulcers

A dissertation submitted in partial satisfaction of the requirements for the degree
Doctor of Philosophy in Nursing

by

Arneta Rochelle Finney-Beverly

2018

ABSTRACT OF THE DISSERTATION

Examining the Nutritional Status and Nutrition Intake of Community Dwelling Non-Ambulatory Individuals with a Spinal Cord Injury With and Without Pressure Ulcers

by

Arneta Rochelle Finney-Beverly

Doctor of Philosophy in Nursing

University of California, Los Angeles, 2018

Professor Barbara M. Bates-Jensen, Chair

Background: Spinal cord injury (SCI) can be a devastating event causing a significant burden to individuals, their family members and society. In the United States (US), it is estimated 276,000 individuals are living with a SCI and it is projected that 12,500 new SCI cases are reported each year. Individuals with a physical impairment such as SCI often develop a pressure ulcer (PU), which may be prevented. There is a correlation to the development of PU's from poor nutritional status and poor nutritional intake. The purpose of this study was to examine the relationships between macronutrient and micronutrient intake, anthropometric measurements, psychosocial, disability, and nutritional status measurements among community dwelling non-ambulatory persons with a (SCI) with and without (PU's).

Methods: Participants were SCI individuals living in the community with and without a PU and were recruited from home health agencies and SCI rehabilitation facilities. Data was collected using structured questionnaires, nutritional assessment tools, skin assessment, and

anthropometric measurement over 4 days consisting of one initial visit and a second visit on day four. Macro and micronutrient intake data was collected using a 3-day self-reported food log. Psychosocial factors were measured via structured questionnaire administered during the initial home visit. Nutritional status measurements included the Mini Nutritional Assessment-Short Form, World Health Organization Assessment Schedule (WHODAS) 2.0, and Spinal Cord Injury-Secondary Condition Scale (SCI-SCS). The sample included 80 participants, 40 with and 40 without PUs.

Results: This study found significant and clinical differences in micro and macronutrient intake among participants with and without PU indicating persons with SCI are at some nutritional risk.

Conclusions: Participants consumed inadequate dietary intake in both quantity and quality. Participants with PU are not getting enough protein. Calories are within the recommended daily allowances; however, those calories are coming from cholesterol, carbohydrates, saturated fat, and can lead to decrease in wound healing and increase their risk for secondary condition such as cardiovascular disease.

This dissertation of Arneta Rochelle Finney-Beverly is approved.

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2018

Dedication Page

This dissertation is dedicated to my family and friends. My children Tiffany D. Beverly, Rodney O. Beverly Jr., my brother Darick D. Finney, and my parents Luther and Johnnie Mae Lawson. To my mentors Drs. Gloria J. McNeal and Lisa Jones, thank you for your guidance and support. To my good friend of 19 years Dr. Angela Williams whom together we achieved our Bachelor of Science (BSN), Master in Nursing (MSN), Family Nurse Practitioner (FNP), and now our Doctor of Philosophy in Nursing (PhD) together. What an educational journey we have accomplished together my friend. Lastly, a special feeling of thankfulness, gratitude, appreciation, and support from my amazing and loving husband of 24 years, Rodney O. Beverly who was always supportive and encouraged me to hang in there when I wanted to quit. Thank you, "Sweetheart, I Love You".

I leave you with this quote "Believe and Act as if it were Impossible to Fail"

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Chapter I

Introduction

Background

A spinal cord injury (SCI) is damage to any part of the spinal cord or nerves at the spinal canal that leads to temporary or permanent injury, results in loss of function, strength, sensation, paralyzes or changes in autonomic function. Injury generally begins with a blow or a sudden traumatic injury to any portion of the spine resulting in dislocation or fractures of the vertebrae (NIH, 2015). Broken bone or disc material can be displaced tearing into the spinal cord. The spinal cord can be damaged and does not need to be severed to be injured. Common causes of SCI damage range from trauma resulting from motor vehicle accidents, falls, or diseases such as cancer, arthritis, or osteoporosis.

Spinal cord injury can be a devastating event causing a significant burden to individuals, their family members and society (Noonan, Fingas, Farry, Baxter, Singh, Fehlings, & Dvorak, 2012). Approximately 276,000 individuals in the United States (US) are living with a SCI and it is estimated that 12,500 new SCI cases are reported each year (NSCISC, 2015). This number is expected to increase to over 13,500 annually by 2020 and over 17,500 by 2050 (DeVivo, 2012). Reasons for this anticipated increase in SCI is due to gender difference risk factors as well as the aging of the population.

DeVivo and colleagues (2012), stated SCI is 3 to 4 times more likely to occur in men than in women. This may be due to the over-representation of men in sports/recreational activities (Ellis 2014 & Van Rheenen, 2013) and/or work-related activities that prone males to injury more than females. DeVivo and Chen (2011) also reported that the median age for those with SCI has increased over the years from 28 years in the 1970's to 37 years between 2005 and

2008. If this trend continues, it is estimated that an increase in SCI in an older cohort of the population will occur.

Cost of Spinal Cord Injury

The personal and financial burden associated with the treatment and rehabilitation of SCI has been described as enormous (Chen, Tang, Voge, & DeVivo, 2013 Fehlings and Nguyen (2010). The estimated cost for acute care hospitalization and rehabilitation, in addition to life time medical treatments and loss in wages/earning, is well over 9 million dollars for each person with an SCI. Despite the enormous financial cost associated with SCI, and the modest benefit of clinical treatments (given the relative inability of the body to repair such SCI damage), these healthcare expenses cannot compare with the personal burden faced by the individual and their family. These burdens include debilitating physical and mental consequences, decreased quality of life, and an emotional toll that can be long-lasting regardless of the traumatic or non-traumatic characterization of the SCI (Oyinbo, 2001).

Etiology of Spinal Cord Injury

Globally, the etiology of SCI has a wide-range of sources ranging from accidents and injuries to incidences of violence (Lee & Thumbikat, 2015). The etiology of SCI can be divided into two subgroups: traumatic and non-traumatic (Ones et al., 2007). Traumatic SCI is more common, occurring four times more frequently than non-traumatic SCI and is defined an injury to the spinal cord as a result of an accident or another injury. These injuries can be caused by falls, motor vehicle accidents, suicide attempts, and acts of violence such as gunshot wounds and sports (DeVivo & Chen 2011; NSCISC, 2014). Non-traumatic SCI is less common than traumatic SCI and is generally reported as a result of illness or disease such as cancer, arthritis, and from preventable conditions such as spinal stenosis, abscess caused by viral, bacterial,

candidiasis, parasitosis infections, tumor compression, death to vascular tissue, transverse myelitis, neuronal motor disease, and syringomyelitis (Kirshblum, Groah, McKinley, Gittler, & Stiens, 2002). Non-traumatic SCI occurs more frequently in the elderly population, and as the general population ages non-traumatic SCI may increase, narrowing the difference in incidence between traumatic and non-traumatic SCI.

Secondary consequences of SCIs can seriously compound mortality and morbidity. The combination of autonomic disturbances following an SCI event can affect the progression of cardiovascular disease by accelerating its progression (Phillips, Cote, Bredin, Krassioukov, & Warburton, 2012; Miyatani, Masani, Oh, Miyachi, Popovic, & Craven, 2009). The initial reaction to SCI is a neurogenic shock, followed by blood pressure instability and orthostatic hypotension and autonomic dysreflexia. These reactions, combined with various lifestyle factors, may lead to an accelerated cardiovascular disease (CVD) experience following a diagnosis of SCI. With SCI, individuals can experience limited mobility, nervous system dysfunction, and increased inflammatory response causing the premature onset of CVD (Charlifue, Jha, & Lammertse, 2010; Hitzig, Campbell, McGillivray, Boschen, & Craven, 2010; Frost, Roach, Kushner, & Schreiber, 2005). Persons with SCI's also experience limited activity, sedentary lifestyles, and weight gain (Lai, Lin, Chang, Lin, Lee, Sung, & Kao, 2014). According to finding by Liang Chen, Wang, Rimmer, and Braunschweig (2007), persons with SCI can eventually suffer from abdominal obesity, increased body fat, and decreased lean body mass further contributing to CVD risk as well as to pressure ulcer (PU). This progression to PUs can cost a considerable amount of money, time, and effort. Best estimates report PU care approached $11 billion annually, as each individual PU event can range from $500 to $70,000 (NPUAP, 2014; Stroup, Manheim, Evans, Guihan, Ho, & Li, 2011). Given the lifetime risk of

this population, researchers estimate that the risk for PUs will increase over the years, thus, efforts to identify risk factors in order to implement preventative measures is needed (Gould, Olney, Nichols, Block, Simon, & Guihan, 2014).

The annual incidence of PU development in persons with SCI is reported to be as high as 30 percent. It is estimated over the life span of a person with a SCI, PU development will rise to over 70 percent annually (Raghavan, Raza, Ahmed, & Chamberlain, 2010). There are limited studies examining the incidence and prevalence of PU development in persons with SCI living in the community, however, persons with SCI will develop in most if not all PU's in the community setting (Raghavan, Raza, Ahmed, & Chamberlain, 2010).

Furthermore, with the increasing proportion of an older population that reports increased risk of falls (Lee & Thumbikat, 2015), SCIs associated with falls has increased from 17 percent in the 1970s to 28 percent by 2011. Another area of SCI increase is due to interpersonal violence, causing 13 percent of spinal cord injuries prior to 1980, and peaked between 1990 and 1999 at 25 percent before declining to only 14 percent since 2010 (NSCISC, 2013). The only causative recreational area reporting SCI decline is in sports and activities, which has consistently reported declining SCI for the past 30 years (from 1970 to 2000) and then stayed steady over the last 10 years (2000-2010) (Chen, Tang, Vogel, & DeVivo, 2013). Motor vehicle accidents have continued to be the leading cause of SCI over the past 40 years, accounting for 40 – 50 percent of all SCIs (NSCID, 2013; Chen, Tang, Voge, & DeVivo, 2013).

Polinder, Meerding, Mulder, Petridou, and Van Beeck (2007) studied six European countries and found that SCI, in addition to brain and skull injury, resulted in permanent disability having the highest disease burden. These burdens are associated with secondary medical complications of the circulatory system, genitourinary system, respiratory system,

musculoskeletal system, the skin or pain (WHO, 2013), as well as secondary health conditions, PU, autonomic dysreflexia, or pneumonia/atelectasis (McKinley, Jackson, Cardenas, & Michael, 1999), requiring extensive medical attention (Furlan, Sakakibara, Miller & Krassioukov, 2013).

Given the secondary problems of SCI (PU, urinary tract infection, deep vein thrombosis, spasticity, pain respiratory problems, and autonomic dysreflexia) that are associated poor outcomes, there is a need for rehabilitation programs, and specifically attention to recommended screenings to identify and control SCI-specific medical problems with early detection and intervention thus preventing secondary complications (Arora, Harvey, Lavrencic, Bowden, Nier, Glinsky, Hayes, & Cameron, 2015). During clinical screenings, attention to secondary conditions such as urinary tract infection and dysfunction, PU, and infections, as well as other CVD risk factors, need identification and treatment (Frank et al., 2012). Garshick, Kelley, Cohen, Garrison, Tun, Gagnon, & Brown (2005) note that increased mortality in persons with SCI is also found with persons who have treatable or preventable risk factors. A change in lifestyle habits to healthier physical and dietary habits is recommended to help avoid these risk factors (De Groot, Dallmeijer, Post, Angenot, & van der Woude, 2008). Identifying suitable physical activities specifically coordinated for this patient population can be difficult and rests heavily upon the level of injury, secondary problems, and extent of paralysis (Frank et al., 2012).

Spinal Cord Injury's Comorbidities

Comorbidities associated with SCIs include those physical and mental conditions that negatively affect the health of those with SCI. Physical comorbidities include diabetes, obesity, and dyslipidemia. Mental conditions associated with comorbid conditions include such psychological disorders as depression, drug dependence, Post-Traumatic Stress Disorder, and bipolar disorder (Craig, Perry, Guest, Tran Dezarnaulds, Hales, Ephraums, & Middleton, 2015).

These SCI-related co-morbidities may be responsive to therapeutic attention and to lifestyle changes (Ayyub, Khan, Hashim, Waheed, & Ali, 2015). Such recommended changes include dietary, weight loss, and increased physical activity, as well as provider prescribed medication and rehabilitation. Attention to comorbid conditions is important so that the SCI can be addressed without the additional burden of extra physical and mental health problems.

Cardiovascular Disease

Cardiovascular disease (CVD) is of particular concern following an occurrence of SCI. Because CVD is the leading cause of death in the general population, the additive influx of additional cases of CVD following SCI is cumulative. This association of CVD following SCI is thought to be due to the disruption of autonomic pathways that lead to unstable cardiovascular systems, increasing blood pressures and heart rates. Transient episodes of abnormally low and high blood pressure (called orthostatic hypotension and autonomic dysreflexia, respectively) can be experienced by the majority of SCI individuals on a daily basis (West, Mills, & Krassioukov, 2012). The increasing occurrences and impact of autonomic dysfunction after SCI has led to providers' and researchers' desire to be better equipped to respond to these events. A better understanding of the long-term consequences of these conditions will contribute to better management of CVD morbidity and mortality in this population (Phillips & Krassioukov, 2015).

Diabetes Mellitus

In type 2 diabetes, the most common form of diabetes affecting 95 percent of all cases, insulin is produced but is not used properly (called insulin resistance), resulting in hyperglycemia or high blood glucose levels. Initially, the pancreas produces extra insulin in an attempt to alleviate the glucose levels. Over time, however, the pancreas is not able to produce sufficient

insulin to maintain normal blood glucose levels, resulting in hyperglycemia and disabling complications such as loss of limbs, eyesight, poor circulation and skin disorders (ADA, 2015).

Because there is increased metabolic issues with those diagnosed with type 2 diabetes, and because abnormalities are observed in carbohydrate and lipid metabolism among those with SCI (Bauman & Spungen, 2000), type 2 diabetes has been recognized as a serious comorbid condition that further exacerbates SCI conditions. Studies have shown that persons with SCI have an increased risk for insulin resistance, atherogenic lipid profile, and metabolic syndrome, which are precursors of type 2 diabetes and macrovascular disease (Banerjea, 2007). Thus, individuals with SCI may be at a higher risk for type diabetes at earlier ages, and type 2 diabetes may contribute to SCI complications such as PU and decreased mobility.

Pressure Ulcers

Pressure ulcers, injury to the skin or tissue caused by unrelieved pressure, is generally found over a bony prominence such as the tail bone, heel or elbow. PU's are commonly found in patients who have a disability or who are subjected to prolonged resting periods (Bouten, Oomens, Baaijens, & Bader, 2003). The patient's quality of life and the economic impact of PUs impose an important financial concern for the patient, their family, insurers, and health service institutions.

In a longitudinal, two-panel, cohort study of 118 men (Garber, Rintala, Hart, & Fuhrer, 2000), PU occurrence was as high as 23 percent in the first one to five years after the onset of SCI and increased to 60 percent after six years of onset of SCI. Seventeen percent of individuals with SCI of five years or longer duration develop a PU every two years; 9 percent will develop one PU every year; and 4 percent will continuously have a PU (Krause & Broderick, 2004). Rates of PU recurrence among persons with SCI are as high as 79 percent (Bates-Jensen,

Guihan, Garber, Chin, & Burns, 2009). Hospital admission for PU's among patients with SCI results in increased length of stay and may require reconstructive surgery and necessary supplies and attention such as special mattresses, dressings, treatments and community nursing. Health care delivery systems will need to focus on not treating acute illness but rather, focus on preventive care in the community and management of chronic conditions such as PU, type 2 diabetes, and CVD (Roach, Nagy, Mejia, & Nemunaitis, 2013). In this vulnerable population, one aspect in preventing CVD, type 2 diabetes, and PU is nutritional management.

According to a published report by the National Pressure Ulcer Advisory Panel (NPUAP, 2014), under-nutrition, unintentional weight loss, protein energy malnutrition, and dehydration are all factors that contribute to the development of PU in individuals with SCI. Stevenson et al. (Stevenson, Collinson, Henderson, Wilson, Dealey, McGinnis, & Nixon, 2013) identified primary risk factors for the development of PUs in SCI as decreased mobility, inactivity affecting skin perfusions, type 2 diabetes, inadequate nutrition, and skin moisture. PU's are categorized according to visible skin and tissue damage. The National Pressure Ulcer Advisory Panel classified PU's into six stages shown in Table 1-1.

Individuals with a physical impairment such as SCI often develop a PU, which may be prevented through care with circulation and movement (Reddy, Gill, & Rochon, 2006). The incidence rate of PU among persons with SCI is between 0.4 to 38 percent in acute care, 2.0 to 23 percent in long term care, 0 to 17 percent in home care (Graves, Birrell, & Whitiby, 2005) and 23 percent and 30 percent persons with SCI in home care (Byrne & Salzberg, 1996). PU's can lead to prolonged hospital stay, an increase in infections, pain, and recovery (Graves, Birrell, & Whitiby, 2005).

Obesity

Over the last few decades, the prevalence of obesity has soared in the US dramatically posing a major public health challenge. An imbalance of dietary intake and decrease in physical activity are primary causes of obesity (Swinburn, Sacks, Hall, McPherson, Finegood, Moodie, & Gortmaker, 2011). According to the US Surgeon General's position paper titled "Vision for a Healthy and Fit Nation" (2010) obesity is believed to have contributed to over 110,000 preventable deaths, and obese persons are at increased risk for other chronic conditions such as high blood pressure (HTN), high cholesterol, type 2 diabetes and its complications, coronary heart disease (CAD), stroke, gallbladder disease, osteoarthritis (OA), sleep apnea, and respiratory problems, as well as endometrial, breast, prostate, and colon cancers (Benjamin, 2010). This growing obesity epidemic in the US is evident by the number of persons diagnosed with type 2 diabetes since the 1980's. Ogden and Carol report results from the National Health and Nutrition Examination Survey (NHANES, CDC, 2005-2006) website showing a significant increase in obesity from 1960-1962 through 2005-2006. Thirty-two percent of adults over the age of 20 were overweight and 34.3 percent were obese and nearly 6 percent were extremely obese (Ogden & Carroll 2010).

A study by Finkelstein, Trogdon, Cohen, and Dietz (2009) identified over $145 billion dollars attributed to obesity alone in 2008. The annual cost of obesity doubled since 1998 placing an economic burden on public and private payers. Obese persons are at increased risk for other chronic conditions such as HTN, high cholesterol, type 2 diabetes and its complications, CAD, and stroke, (CDC). However, studies by Bauman (2001), Imai, Kadowaki, Aizawa, & Fukutomi (1994), and Yekutiel et al. (1989) documented that these chronic conditions were more common in persons with SCI and obesity in comparison to the able body person with obesity.

Anson and Shepard (1996) noted that persons with SCI who were overweight or obese were observed to have an increase in medical complications versus the ideal body weight category person.

Persons with SCI, according to Chen, Henson, Jackson, and Richards (2006), often face additional burdens associated with excessive weight. These burdens are social stigmatization, discrimination, and diminished physical functioning, independence, and community integration. Often time persons with an SCI do not appear to be obese; however, body fat mass and or fat tissue has been documented to be greater in this population (Jones, Legge, and Goulding, 2003). The prevalence of obesity in persons with SCI has varied between studies, but Anson & Shepard (1996), Johnston, Diab, Chu, & Kirshblum (2005), Smith, Rajan, & Gater (2007), Tomey, Chen Wang, & Braunschweig (2005), Weaver, Collins, Kurichi, Miskevics, Gupta, White, & Sanford (2006) found that obesity prevalence among persons with SCI is between 40-66 percent compared to 35 percent (CDC 2015, Ogden & Carroll 2014) The same studies demonstrated obesity is higher in persons with paraplegic versus persons with tetraplegia.

Those individuals with SCI are at a greater risk for obesity compared to the able-body population. The current definition of obesity, unfortunately, has lead healthcare practitioners into a false sense of security regarding the health of their patients and the dangers of obesity (Gater, 2007).

Nutritional Inadequacy

Advancements have been made in managing SCI medically, however, nutritional inadequacy, intake of total fat, and lack of exercise have contributed to an increase in CVD, one of the leading causes of death for a person with SCI (Walters, Buchholz, & Ginis, 2009). Sedentary lifestyle, glucose tolerance, insulin resistance, and an increase in body mass index

after injury can lead to CAD in persons with SCI in comparison to the non-SCI population. Co-morbidities such as obesity, hypertension, type 2 diabetes, hyperinsulinemia, and hyperlipidemia have increased with SCI individuals (Walters, Buchholz, & Ginis, 2009). According to Tomey, Chen, Wang, and Braunschweig (2005), paralyzed individuals who have excessive weight are more at risk for chronic secondary conditions (CVD, Diabetes, PU, etc.) than the general population. Proper nutrition and eating a healthy diet are essential in preventing and treating CVD and type 2 diabetes; however, with SCI in addition to CVD and type 2 diabetes, proper nutrition may be a challenge (Tomey, Chen, Wang, & Braunschweig, 2005). Nutritional factors are often neglected or overlooked in the plan of care for persons with SCI who may be at increased risk for developing PU's. Current clinical practice guidelines for prevention and treatment of PUs include a complete nutritional component that includes nutritional assessment, intervention, evaluation, and follow-up of nutritional status (NPUAP, 2014).

Mathus-Vliegen (2001) stated there is a correlation to the development of PU's from poor nutritional status and poor nutritional intake. Low body weight and decreased oral intake are risk factors for poor nutrition (Schols & de Jager-v.d, 2004). People with SCI who have recently loss a large amount of weight and are unable to consume adequate calories are considered at risk for poor nutrition which increases their chances for PU development. The need to increase calorie intake by an additional 50 percent over the required number of calories for daily intake is recommended to prevent the development of PUs (Miller & Wolf, 2008; Streat, Beddoe, & Hill, 1987).

There is little information related to dietary intake and nutritional support for a person with SCI (Walters, Buchholz, & Ginis, 2009). The required nutritional intake to prevent the development of PU in person with SCI is unclear and further examination of this issue is needed.

Statement of the Problem

Spinal cord injury can be a devastating event causing a significant burden to an individual, their family, and society (Noonan, Fingas, Farry, Baxter, Singh, Fehlings, & Dvorak, 2012). Metabolic changes occur with SCI due, in part, to muscle atrophy from missing muscle innervation of paralyzed limbs. With muscle atrophy, there is an increase in relative body fat mass (Spungen, Wang, Pierson, and Baumann, 2000). When these alterations occur in persons with SCI along with inactivity or sedentary lifestyles, carbohydrate and fat metabolism is disturbed predisposing individuals to increased cardiovascular risk factors such as glucose intolerance, insulin resistance, obesity, hyperinsulinemia, dyslipidemia, and hypertension (HTN) (Bauman & Spungen, 2000). According to Emmons, Garber, Cirnigliaro, Kirshblum, Spungen, & Bauman (2011), two-thirds of persons with SCI are obese, further increasing their risk. This is significant for the SCI population because their life expectancy is decreased due to increased risk of CVD (Perret & Stoffel-Kurt, 2011). A physical impairment such as SCI often can lead to PU which can be preventable (Reddy, Gill, & Rochon, 2006). Pressure Ulcers, prolonged wound healing, and digestion problems are some of the secondary conditions for SCI individuals. Nutritional deficiencies can adversely impact the outcomes of these secondary conditions (Aquilani, Boschi, Contardi, Pistarini, Achilli, Fizzotti, & Pastoris, 2001; Perret & Stoffel-Kurt, 2011).

Purpose of the study

This study examined the nutritional status among community dwelling non-ambulatory persons with a SCI with and without PU's. Specifically, this study explored the relationship between, macronutrient intake, micronutrients intake, anthropometric measurements, psycho-

social factors, disability status measurements, and nutritional status among community dwelling non-ambulatory persons with a SCI with and without PU's

Summary

Spinal cord injury can be a devastating event causing a significant burden to individuals, their family, and society (Noonan, Fingas, Farry, Baxter, Singh, Fehlings, & Dvorak, 2012). Spinal cord injuries are increasing over time (Shavelle, DeVivo, Brooks, Strauss, & Paculdo, 2015) and secondary complications result in comorbidities such as PUs, CAD, urinary complications, pulmonary complications, sexual dysfunction, gastrointestinal complications, bone metabolism, musculoskeletal complications, pain syndromes, neurological deterioration, thermoregulatory dysfunction and function deficits (Grossman, Frankowski, Burau, Toups, Crommett, Johnson, & Harrop, 2012).

Advancements have been made in medically managing SCI; however, nutritional inadequacy, intake of total fat, and lack of exercise, have contributed to an increase in CVD, one of the leading causes of death for a person with SCI (Walters, Buchholz, & Ginis, 2009). Attention to the management and control of these issues of nutrition and physical activity is needed. This study added to our body of knowledge regarding SCI and factors that need to be considered in the management of SCI that includes nutrition, obesity, and PUs.

Table 1-1 Pressure Injury Staging Guidelines

Category/Stage 1 Pressure Injury: Non-blanchable erythema of intact skin: Intact skin with a localized area of non-blanchable erythema, which may appear differently in darkly pigmented skin. Presence of blanchable erythema or changes in sensation, temperature, or firmness may precede visual changes. Color changes do not include purple or maroon discoloration; these may indicate deep tissue pressure injury
Category/Stage 2 Pressure Injury: Partial-thickness skin loss with exposed dermis: Partial-thickness loss of skin with exposed dermis. The wound bed is viable, pink or red, moist, and may also present as an intact or ruptured serum-filled blister. Adipose (fat) is not visible and deeper tissues are not visible. Granulation tissue, slough and eschar are not present. These injuries commonly result from adverse microclimate and shear in the skin over the pelvis and shear in the heel. This stage should not be used to describe moisture associated skin damage (MASD) including incontinence associated dermatitis (IAD), intertriginous dermatitis (ITD), medical adhesive related skin injury (MARSI), or traumatic wounds (skin tears, burns, abrasions).
Category/ Stage 3 Pressure Injury: Full-thickness skin loss: Full-thickness loss of skin, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. The depth of tissue damage varies by anatomical location; areas of significant adiposity can develop deep wounds. Undermining and tunneling may occur. Fascia, muscle, tendon, ligament, cartilage and/or bone are not exposed. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury
Category/ Stage 4 Pressure Injury: Full-thickness skin and tissue loss: Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining and/or tunneling often occur. Depth varies by anatomical location. If slough or eschar obscures the extent of tissue loss this is an Unstageable Pressure Injury.
Unstageable Pressure Injury: Obscured full-thickness skin and tissue loss in which the extent of tissue damage within the ulcer cannot be confirmed because it is obscured by slough or eschar. If slough or eschar is removed, a Stage 3 or Stage 4 pressure injury will be revealed. Stable eschar (i.e. dry, adherent, and intact without erythema or fluctuance) on an ischemic limb or the heel(s) should not be removed.
Deep Tissue Pressure Injury (DTPU): Persistent non-blanchable deep red, maroon or purple discoloration Intact or non-intact skin with localized area of persistent non-blanchable deep red, maroon, purple discoloration or epidermal separation revealing a dark wound bed or blood filled blister. Pain and temperature change often precede skin color changes. Discoloration may appear differently in darkly pigmented skin. This injury results from intense and/or prolonged pressure and shear forces at the bone muscle interface. The wound may evolve rapidly to reveal the actual extent of tissue injury, or may resolve without tissue loss. If necrotic tissue, subcutaneous tissue, granulation tissue, fascia, muscle or other underlying structures are visible, this indicates a full thickness pressure injury (Unstageable, Stage 3 or Stage 4). Do not use DTPU to describe vascular, traumatic, neuropathic, or dermatologic conditions.

Source: National Pressure Ulcer Advisory Panel (2014) http://www.npuap.org/resources/educational-and-clinical-resources/npuap-pressure-ulcer-stagescategories

Chapter II

Review of Literature

Introduction

A changing demographic within the US demands more attention to the rise in disabling conditions, including spinal cord injury (SCI) and pressure ulcers (PU). The national disability burden is significant, thus understanding its impact on individuals and families can help to direct medical care costs and resources, as well as to better use limited funds, while developing key research projects that may have a greater potential for improving SCI medical care and treatment outcomes (Ma, Chan, & Carruthers, 2014).

The immediate and direct consequences of SCI may result in a number of secondary conditions. These conditions vary greatly among individuals, even among those with similar injuries. For example, PUs partially occurs as a result of the inability to feel pain in a pressure area (due to sensation loss) as well as the inability to shift weight naturally (due to mobility loss) (Krause & Broderick, 2004). Poor diets can lead to secondary conditions associated with obesity such as cardiovascular disease (CVD), type 2 diabetes, and metabolic syndrome (Khalil, Gorgey, Janisko, Dolbow, Moore & Gater, 2013). Unfortunately, little is known about the relationship between dietary intake, obesity and CVD risk factors in the chronic SCI population (Lieberman, Goff, Hammond, Schreiner, Norton, Dulin, Zhou et al., 2014). Although individuals with SCI are living longer partly due to advances in medical practice and technology, they are suffering from chronic diseases such as obesity, their quality of life is shortened, and the ability to extend their lives is reduced (Kim, Nam & Shin, 2013). Studies by Rajan, McNeely, Warms, and Goldstein

(2008) report that persons with SCI are living an average of more than 40 more years after injury making persons with SCI just as prone to the same conditions that affect able bodied persons.

The purpose of this study was to explore the relationship between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, disability status measurements, and nutrition status measurements observed among community dwelling non-ambulatory persons with a SCI with and without PU's. This review of the literature pays particular attention to the nutritional intake of the person with a SCI by examining self-reported 3-day food logs and skin assessments, which reflect nutritional intake and determine special nutritional requirements. The literature review provides an overview of the prevalence and burden of SCI, a review of SCI including its comorbid conditions (cardiovascular disease, obesity, PU), and examines the key nutritional issues related to this study.

Prevalence and burden of SCI

The economic impact of SCI on health care costs and on the healthcare system has become an increasingly important topic for researchers and policy makers (Singh, Tetreault, Kalsi-Ryan, Nouri, & Fehlings, 2014). It is estimated that globally in 2007, there would have been between 133 and 226 thousand incident cases of traumatic SCI from accidents and violence (Lee, Cripps, Fitzharris, & Wing, 2014). A global-incident traumatic SCI rate (2007) is estimated to be 23 cases per million (or 179 312 cases per annum). Regional incidence data are available from North America (40 per million), Western Europe (16 per million) and Australia (15 per million). Extrapolated regional data are available for Asia-Central (25 per million), Asia-South (21 per million), Caribbean (19 per million), Latin America, Andean (19 per million), Latin America, Central (24 per million), Latin America-Southern (25 per million), Sub-Saharan

Africa-Central (29 per million), Sub-Saharan Africa-East (21 per million) (Lee, Cripps, Fitzharris, & Wing, 2014).

In the US the average annual cost for the treatment of patients with acute traumatic SCI for all emergency department visits from 2007–2009 was $1.6 billion. Even though hospital emergency department visits decreased between 2007 and 2009, there was a reported increase in the cost of health care and medical traumatic SCI expenditures (Selvarajah et al., 2014). An explanation for this increased cost may be due to increased patient incidence at trauma centers. Other possible explanations include presentation of more severe/multiple injuries and increased diagnostic tests or increased prescriptions expenditures (Selvarajah et al., 2014).

According to Krueger et al. (2013) the estimated lifetime economic burden associated with SCI ranges from $1.47 million for a person with incomplete paraplegia to $3.03 million for one with complete tetraplegia. These estimates include complications in the early surgical phase, such as wound infections and displaced instrumentation; emergency readmissions; and long-term complications including PUs, bladder and bowel dysfunction, neuropathic pain, and respiratory problems (Singh, Tetreault, Kalsi-Ryan, Nouri, & Fehlings, 2014). Annually, the projected economic burden associated with SCI in Canada is $2.67 billion ($1.57 billion in direct costs and $1.10 billion in indirect costs) and includes costs associated with hospitalizations ($0.17 billion, or 6.5% of total costs), health care provider visits ($0.18 billion, or 6.7%), equipment and home modifications ($0.31 billion, or 11.6%) and attendant care ($0.87 billion, or 32.7%) (Singh, Tetreault, Kalsi-Ryan, Nouri, & Fehlings, 2014). The rising cost of health care is a major reason for increased costs for the treatment of SCI (Consortium for spinal cord medicine clinical

practice guidelines, 2008; Korley, Pham & Kirsch, 2010; Willenberg, Curtis, Taylor, Jan, Glass, & Myburgh, 2012).

Spinal Cord Injury

Traumatic SCI is a devastating assault to the central nervous system (CNS) that often results in permanent neurologic impairment, intense personal suffering and a disruption to essentially every aspect of life (Nedergaard, 2014). SCI manifests in two phases: the acute events in primary injury typically result in damage or disturbance to the neuronal elements of the spinal cord, leading to the severing of axon tracts and neuronal cell death. However, within one to three days of the initial injury, SCI patients often experience a cascade of secondary pathological changes that amplify the initial traumatic injury and result in edema, spreading necrosis, inflammation, ischemia, and proliferation of reactive glial cells (Nedergaard, 2014). Although little is known about the pathogenesis of this secondary phase, histological study has revealed a distinctive pattern of cellular events: in what appears to be a defense mechanism aimed at halting the spread of cellular damage, the injured neural tissue becomes isolated from surrounding healthy tissue by the formation of what is commonly referred to as the glial scar, consisting of a dense core of fibroblasts, surrounded by a symmetrical wall of reactive astrocytes (Nedergaard, 2014).

It is estimated that approximately 50 to 70 percent of the US population is exposed to a traumatic event sometime during their lifetime (Ursano, 2009). Following a traumatic event, many individuals are then left with a disabling condition such as SCI. Approximately 200,000 individuals in the US are reported to have a disability due to a SCI. Over 50 percent of these disabilities are tetraplegia and 47 percent are paraplegia disabled (Tomey, Chen, Wang, & Braunschweig, 2005).

The demographic characteristics of SCI has shifted over the past twenty years; African Americans with SCI doubled from 14 to 29 percent, White individuals with SCI decreased from 77 percent to 70 percent and Hispanics with a SCI increased from six percent to twelve percent over the same time period. The major cause contributing to SCIs are acts of violence, primarily gunshot wounds, which has increased steadily since 1973, especially in minority populations (NSCISC, 2000). Meanwhile, a shift in the primary cause of mortality associated with SCI changed from infectious diseases to chronic diseases and examining the role of chronic diseases among persons with SCI has been a topic for research (Whiteneck, 1992; and Cragg, Noonan, Krassioukov & Borisoff 2013). As a result of direct trauma to the spinal cord cardiovascular injury may occur (Shan & Tisherman. 2014). CVD is the leading cause of death for many of those with a SCI, and CVD is noted to occur more frequently among younger individuals with a SCI in comparison with those who are able-bodied (Whiteneck, 1992; Myers, Lee, & Kiratli 2007; and Cragg, Noonan, Krassioukov & Borisoff 2013).

Comorbidities

Comorbid conditions associated with SCI are important as they affect health outcomes. For instance, metabolic changes occur in individuals with SCI, as muscles tend to atrophy from paralyzed limbs. Following muscle atrophy, an increase in body fat leads to obesity (Spungen, Wang, Pierson, & Baumann, 2000). Given inactivity or sedentary lifestyles, the body reacts poorly with carbohydrate and fat metabolism predisposing individuals to increased comorbid conditions such as CVD, glucose intolerance, insulin resistance, obesity, hyperinsulinemia, dyslipidemia, and HTN (Bauman & Spungen, 2000). According to Emmons et al. (2011) a substantial number of individuals with SCI (two thirds of all SCI population) are obese, increasing their risk of comorbid conditions.

Cardiovascular Disease

Mortality rates for CVD among persons with a SCI are 228 percent higher than the general population (Cragg, Noonan, Krassioukov and Borisoff 2013). Researchers report CVD in SCI is primarily due to the presence of HTN, which is 2-3 times higher than those in able-bodied populations (matched by age and sex) (Cragg, Noonan, Krassioukov, & Borisoff 2013; Myers, Lee, & Kiratli 2007) as reported by Cragg and colleagues. They evaluated the association between CVD and SCI and demonstrated SCI was also associated with a significant increased odds of heart disease (adjusted odds ratio [OR] 5 2.72, 95% confidence interval [CI] 1.94–3.82) and stroke (adjusted OR 5 3.72, 95% CI 2.22–6.23), indicating a need for intervention and prevention in modifying risk factors for CVD in individuals with SCI.

Wu and colleagues evaluated the incidence of stroke in patients with disability caused by SCI. Results show stroke was more likely to occur in the individual with SCI ($p < .001$), putting persons with SCI at a higher risk of stroke, especially the ischemic type ($p< .001$) (Wu, Chen, Liu, Chen, Huang, Cheng, & Tung-Ping 2012).

In addition, the SCI population is reported to have lower HDL cholesterol than the sedentary able-bodied population, thus they may be facing a higher risk for lipid induced CVD (Bostom, 1991; Dearwater, 1986; Brenes, 1986; Maki, 1995). Because SCI individuals generally live a sedentary lifestyle with little or no vigorous physical activities, the risks for CVD, obesity and HTN are even higher (Washburn, 1998).

Another factor that contributes to changes in body composition and CVD risk is poor dietary habits. An assessment of carbohydrate intake of 33 individuals with SCI reported lower carbohydrate intake but higher than recommended total fat (Levine, 1992). Having poor dietary habits with low physical activity is an additional CVD risk for the SCI population. Because few

studies have investigated the dietary intake of SCI individuals, there is a need for studies that increase knowledge of the role of dietary intake, eating habits and the development of comorbid secondary condition such as CVD in the SCI population.

Obesity

Obesity is a significant co-morbid condition, particularly among those with SCI, (Teramoto, Bungum, Landwer, & Wagner, 2015) and has been associated with a broad range of diseases and metabolic abnormalities that affect several different organ systems in the body via atherogenic, neuro-humoral, and hemodynamic mechanisms in the able-bodied as well as SCI populations (Yarar-Fisher, Chen, Jackson, & Hunter, 2013). Obesity can be defined as "an unhealthy excess of body fat, which increases the risk of medical illness and premature mortality" (Shiriki, Brownson, & Satcher, 2007). Obesity in a person with a disability such as SCI is a common occurrence requiring attention due to risks for CVD and other health conditions (Wong et. al., 2013).

According to Finkelstein, Trogdon, Cohen, and Dietz (2009), obesity- related disabilities among SCI populations are estimated to cost $44 billion dollars annually. Health care costs and poor clinical outcomes have been associated with obesity and are recognized as both reason and consequences of having a SCI. If the condition of obesity continues to be overlooked in persons with SCI, future problems may occur including early death (Wong, 2013).

Pressure Ulcers

Pressure, shear, friction, and microclimate interact as extrinsic factors in the development of PU (Garcia-Fernandez, Agreda, Verdu, & Pancorbo-Hidalgo, 2014 NPUAP & EPUAP, 2014). Skin surface microclimate includes temperature and moisture, and exposure to moisture can lead to moisture-associated skin damage in the sacral area as a result of inflammation of the epidermis

and dermis (Beeckman, Lancker, Hecke, & Verhaeghe. 2014). The development of PUs from unrelieved pressure and shear force is the result of two actions, direct compressive force on tissue leading to hypoxia of the skin and soft tissue by restricting blood flow resulting in cell death and cell deformation leading to apoptosis and cellular death. When pressure reaches magnitudes that deform cells, the resulting injury occurs at the bony tissue interface and is full thickness damage. This also is classified as a deep tissue injury, in that the pressure was applied to the deep tissues (muscle, fascia) and deformed the cells leading to their death (Beeckman, Lancker, Hecke, & Verhaeghe 2014 and Black, 2015). Shear is a tangential (angular) force associated with movement, for example, sliding down in bed or being pulled over to the side of the bed. Shear forces distort blood vessels in the skin, making the effect of pressure more deleterious because the tissue is already hypoxic (Black, 2015). Shear in combination with pressure can cause skeletal muscle around boney prominences to have greater damage and distortion of capillaries (Black, 2015).

A Pressure Ulcer, or injury to the skin or tissue caused by unrelieved pressure, is generally found over a bony prominence such as the sacrum or heels. A PU is categorized according to visible skin and tissue damage. The National Pressure Ulcer Advisory Panel (NPUAP) classifies PU's into six stages shown in Table 1-1. PU's are commonly found in patients who have a disability or who are subjected to prolonged resting periods (Bouten, Oomens, Baaijens, & Bader, 2003). PUs are significant secondary complications often found in individuals with SCI. PUs not only lessens quality of life, but can negatively impact physical functioning, psychological status, emotional/mental health, and financial position of individuals (Gorecki et al., 2009; Gorecki et al., 2012)

Individuals with physical impairment, such as an SCI, often develop one or more PUs - many of which may be preventable (Reddy, Gill, & Rochon, 2006). In a study of 118 men, Garber, Rintala, Hart, & Fuhrer (2000) reported PU incidence occurring in the first 1 to 5 years for persons with SCI. The occurrence of PU was also found to be as high as 23 percent to 60 percent after six years of the onset of injury. Of this sample, 75 percent were observed to have a stage 1 and stage 2 PU. Another study by Fuhrer et al. (2000) randomly selected 140 men with a SCI in a community setting and found that 33 percent of the sample on examination had a PU. Illness and immobility were found to increase with age and are considered risk factors for developing PU. Immobility leads to further risk factors such as poor perfusion to the skin, increase in skin moisture and poor nutrition (Coleman, Gorecki, Nelson, Closs, Defloor, Halfens, et al., 2013).

According to a study by Krause and Broderick (2004), 17 percent of individuals with SCI of five years or more duration will develop a PU every two year. Nine percent will develop one PU every year, and four percent will continuously have a PU. Reported rates of recurrence range from 6 - 61 percent, whether or not treatment involved surgical or medical management (Krause & Broderick, 2004). Limitation in activity, decreased mobility, muscle atrophy, poor nutrition and underweight are a common occurrence (Krause et al., 2001), and are the most common risk factors for person with SCI. Pressure ulcers, prolonged wound healing, and digestion problems are some of the secondary conditions for SCI individuals and nutritional status impacts the outcomes of these secondary conditions (Aquilani et al., 2001; Perret & Stoffel-Kurt, 2011).

Dietary Intake and Spinal Cord Injury

The status of dietary intake has been shown to have a significant effect on co-morbid conditions, which are chronic in nature (Perez-Lopez, Chedraui, Haya, & Cuadros, 2009). These

co-morbid conditions include CVD, obesity and type 2 diabetes (Kopelman, 2000). More recently, there has been increased attention to nutrition and dietary management in acute and chronic phases of recovery SCI patients (Pellicane, Millis, Zimmerman, & Roth, 2013). Because of limited information SCI and dietary intake in past years, current interest is rising due to studies reported by Pellicane, Millis, Zimmerman, & Roth (2013). Pellicane et al. (2013) compared calorie and protein intake in patients with new SCI versus other diagnoses such as traumatic brain injury. Some important associations between calorie ($P = 0.004$) and protein intake ($P = 0.0001$) were found when using t test comparing groups, particularly of dietary intake among individuals with longstanding SCIs. These findings indicate that a comparison of nutrition intake among persons with SCI in comparison to persons with other diagnoses is in line with the current study and may serve to identify excessive dietary intake as a modifiable, SCI-specific medical problem.

The recommended diet for individuals with a SCI supports the maintenance of optimal weight, prevention of muscle wasting, maintenance of well-functioning kidneys, bowels, and healthy skin so that the threat of infections or injury is controlled (Ulmer, 1990). Although there are many factors that may lead to premature mortality and morbidity among those with a SCI, poor nutritional intake has been noted as accelerating CVD in SCI individuals, particularly those who have paralysis and were more so predisposed to comorbidity and mortality (Levine, 1992). Thus, it is important for nurses and caregivers to document information on the SCI individual's eating patterns and other activities (or inactivity) that influence dietary intake leading to morbidity and mortality of chronic diseases.

Nutrition Assessment

Perret and Stoffel-Kurt's (2011) study aim was to compare the nutrition intake of individuals with acute SCI and individuals with chronic SCI. Patients were instructed to record their nutritional intake for seven consecutive days. Perret and colleagues used 26 photos of serving sizes of common food for more accuracy in documenting what patients consumed. They also used bioimepedance techniques and measured resting expenditure to measure body fat in the 24 SCI individuals. The results showed the chronic group's total body fat was significantly higher compared to the acute group (19.4 ± 3.8 vs. 15.7 ± 4.3%) (Perret & Stoffel-Kurt, 2011). Because of the change in environment and lifestyle, individuals with acute SCI were more likely to not have follow-ups on the quality and quantity of nutritional intake, thus resulting in reliance on pre-injury eating habits (Perret & Stoffel-Kurt, 2011). Although these results cannot be used to generalize to the SCI population, this finding support the importance to prevent nutrition-related secondary complications like CVD with individual with SCI, and professional nutritional education must be focused during and after rehabilitation in order to decrease the comorbidities of CVD and thus should be considered (Perret & Stoffel-Kurt, 2011). Education is important for those with SCI, thus individuals with chronic SCI need to be aware of the changes of body composition and the consequences behind individual choices in nutritional intake.

Green and Shea (1992) examined the recall food logs for 33 quadriplegic and paraplegic patients between the ages of 20-30 years for seven consecutive days. Patients were instructed verbally and in writing as to the correct technique to measure and record their intake. The results were tabulated using a standard software package (Food Processor II) and compared to the 1989 Recommended Dietary guidelines for Americans (RDA) for the able body person. The results showed 38 percent of calories were from fat intake which is above the RDA of y%; carbohydrate

calories were 16.5 percent of the total intake which is, below the RDA of z%; dietary protein intake was within a normal range according to the RDA, and RDA for dietary fiber was only 25 percent of the RDA (Green and Shea, 1992). Levine et al. (1992) acknowledges that SCI intake may be quite different than the standard requirement and the general population. This knowledge is helpful when designing nutritional plans and or models as a guideline for SCI population to decrease the incidence of comorbidities.

Research by Bertoli, Battezzati, Merati, Margonato, Maggioni, Testolin, and Veicsteinas (2006) studied 37 mentally challenged and physically disabled subjects between the ages of 15-54. They used World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF) to classify the patients. Anthropometric measurements, body composition to measure fat free mass (FFM), resting energy expenditure (REE), biochemical parameter for measuring lipid profile, plasma glucose, liver function enzymes and a recall of dietary intake for seven consecutive days were performed. The results indicated REE and FFM were lower in disable persons versus the able body persons. Alterations in the cholesterol profile were evident in more than one third of the disabled subjects, whereas fasting glucose intolerance was evident in one fourth. The results demonstrated altered nutrition is associated with inadequacy of dietary intake including fiber, calcium, potassium, zinc, and excessive macronutrients, resulting in decrease in (FFM) and bone mineral content (BMC) (Bertoli et al., 2006). These results further support the need for the current research study.

Moussavi, Garza, Eisele, Rodriguez and Rintala (2002) followed 110 Hispanic, White, African-American men and women with traumatic SCI between the ages of 22 to 82 years to determine serum levels of vitamins A, C, and E among individuals with spinal cord injury (SCI) living in the community, to compare these levels with general population norms, and to assess

their association with demographic and injury-related data (age at onset, time since onset, level and completeness of injury), function, nutritional behaviors, and health status. Recruitment was done by telephone versus standard mail-out surveys. Measures used were American Spinal Injury Association total motor index (ASIA), serum vitamins, and Functional Independence Measures (FIM), Healthy-Promoting Lifestyles Profile (HPLP), Medical Outcome Study 36-item Short-Form Health Survey (SF-36), and PU incidence in the last 12 months. Moussavi and colleagues were able to demonstrate a large proportion of their sample (16-37%) had inadequate levels of vitamins (vitamin A, C, and E) in their blood and the more severe the impairment, the lower the level of serum vitamin A ($P<.001$). Results revealed a need exists for studies that evaluate innovative interventions to include adding vitamin-fortified grains and cereals, or calcium-added orange juice to the diet of persons with SCI to improve their nutritional status, and to determine the effects of such improvement on various functional and health status measures. The results from the above study demonstrates the need for further research to explore the association between macronutrients, micronutrients, anthropometric measurements, among community dwelling individuals with a SCI who are non-ambulatory with and without a PU.

Walters, Buchholz, and Ginis (2009) followed 77 SCI patients over 6 months. The instruments used for their study were anthropometric measurements and a 24-hour diet recall of the patient at baseline and at six months using the multiple pass method. Diet was read back to the participants to account for any errors and to ensure accuracy when recording the information. The outcomes from the study found co-morbidities such as obesity, hypertension, type 2 diabetes mellitus, hyperinsulinemia, and hyperlipidemia to be increased with SCI individuals. Participants nutritional intake related to energy and macronutrients was sufficient (16% protein, 52% carbohydrate, 30% fat) for men and (17% protein, 53% carbohydrate, 28% fat) for women

but inadequate in micronutrients (vitamin-A; 92 and 57%, magnesium; 89 and 71%, folate; 75 and 79%, zinc; 71 and 29%, thiamine; 22 and 14%, vitamin B12; 6 and 29%, vitamin B6; 24% men, vitamin C; 52 and 14% for men and women. Falling below adequate intake was fiber, calcium, vitamin D, and potassium.

Rabadi, Mayanna, and Vincent (2013) studied 147 patients with traumatic SCI to determine the predictors of mortality in veterans with traumatic SCI. The participants were studied over a 12-year period. Patients were assessed in the clinic for urinary tract infection, pneumonia, myocardial infarction, congestive heart failure, and arrhythmias. Follow-up visits consisted of monitoring blood pressures, blood sugars, and lipids. The ASIA Impairment Scale (AIS) was used to measure the level and severity of the SCI. Throughout the 12- year period, death was attributed to pneumonia (21%), urinary infection (14%), and infection of the pressure ulcers (11%); cardiovascular-related, such as congestive heart failure (16%), coronary arterial disease (13%), and atrial fibrillation (2%); and cancer-related (16%). Rabadi and colleagues were able to demonstrate through a Cox regression analysis that age at the time of injury was the predictor of SCI-related mortality. The study suggests that an older aged individual at the time of injury is a significant predictor of mortality following traumatic SCI with patients more likely to die from cardiovascular deaths than the general population. These findings support the need for preventative strategies, including a focus on cardiovascular risk factor management, in order to decrease long-term mortality.

Knight, Buchholz, Ginis, and Goy (2011) studied the association between leisure-time physical activity (LTPA) and adherence to Eating Well with Canada's Food Guide (CFG) in community-dwelling adults with chronic SCI. Leisure Time Physical Activity (LTPA) and diet quality (vegetables and fruit, grain products, milk and alternatives, or other foods) tools showed

that there is not a correlation (all P>0.05) to SCI persons in Canada. Tools were similar to the studies by Walters, Buchholz, and Ginis (2009) and included used 24-hour diet log and diet read back using food models, along with the multiple pass method. An online tracking tool named EATracker was used for the purpose to calculate the number of servings according to the Eating Well with Canadian Food groups (CFG). EATracker was unable to track foods such as pop, jam, and potato chips because CFG recommend limits on the intake of such foods. Weights were completed in clothes without shoes and body measurements were assessed with the participant out of the wheelchair. The findings revealed adherence to eating and physical activity levels were not what was expected. Specifically, they were poor for the 75 participants; (8 were 0% adherent to CFG, 33 were 25% adherent, 23 were 50% adherent, 8 were 75% adherent and 3 were 100% adherent. One-quarter (26.7%) of participants were adherent to each of vegetables and fruit and grain products recommendations, one-third (34.7%) to milk and alternatives and two-thirds (65.3%) to meat and alternatives). The authors suggested three important recommendations: (1) health care personnel should take into consideration the evidence showing SCI diets are poor (2) Just being active does not mean better dietary intake and, (3) SCI individuals' lifestyle behaviors should be prioritized.

A community-based study by Tomey et al. (2005) was designed to evaluate nutritional status, dietary intake, nutrition knowledge, and depression of healthy urban men with chronic SCI and to compare these findings with national guidelines and data. Tomey and colleagues followed 95 people with SCI living in the community between the ages of 20 to 59 years of age. Their study used the 1998 validated original Block semi quantitative 110 question food frequency questionnaire (FFQ) but adjusted the tool to reflect a seven-day dietary intake versus a one-year dietary intake for which the tool was originally created. The Healthy Eating Index was

used to assess overall dietary quality but was modified to reflect a seven-day diet recall. Findings from Tomey and colleagues were similar to Walters et al. (2009) study. Results from Tomey et al. 2009 study demonstrated individuals with SCI diet was high in fat (37%) and included an inadequate amount of fiber, calcium, fruits, and dairy. Fiber was at or below the RDA. Serum cholesterol levels are raised due to the consumption of increased total fat and saturated fat more so than any other nutrient (Tomey et. al. 2009). It is suggested by Tomey and colleagues that men with SCI are not meeting the dietary guidelines of no more than 30% of calories from fat and no more than 10% of calories from saturated fat. The high fat and saturated fat intake among people with SCI are particularly worrisome given their increased risks for cardiac disease and insulin resistance. The results further support the need for the current study with SCI to prevent comorbidities secondary to chronic disease.

In a most recent cross-sectional study by Sabour, Javidan, Vafa, Shidfar, Nazari, Saberi, Rahimi, and Razavi (2012), 162 persons with SCI participated in a yearlong study to assess the dietary intakes in people with SCI based on sex- and injury-related variables. As with previous studies, dietary intake (macronutrient and micronutrient intake) and anthropometric measures (waist circumference) were used. Trained dietitians assessed patient dietary habits using a food frequency questionnaire consisting of 168-items. The findings can be compared to previous studies by Rabadi, Mayanna, and Vincent (2013) with results revealing age of the SCI, time since SCI, the number of calories, and macronutrients in their diet have a correlation with a healthier diet from SCI individuals. There was a significant positive correlation of age and time since injury with fiber intake ($P < 0.05$). The individuals with an incomplete injury consumed significantly more monounsaturated fatty than those with a complete injury ($P = 0.03$).

These finding by Knight, Buchholz, Ginis, and Goy (2011), Sabour, Javidan, Vafa, Shidfar, Nazari, Saberi, Rahimi, and Razavi (2012), and Tomey et al. (2009) suggest nutrition may be an area of special vulnerability for people with SCI supporting research to evaluate effective strategies to improve dietary intake in those with SCI.

Summary

This chapter provided an overview of the prevalence and burden of SCI, a review of SCI including its complications and comorbid conditions (cardiovascular disease, obesity, PU), and examined the key nutritional issues related to this study. There is a dearth of research investigating the relationship between nutrition status and prevention of PU development, however, because the immediate and direct consequences of SCI may result in a number of secondary conditions, information is needed to better understand the morbidity and mortality associated with PU and nutrition for persons with PUs.

The literature indicates that SCI adds a burden of cost to the individual, family, community and healthcare industry. Studies report that individuals with SCI suffer from co-morbid health conditions, are at risk of dying at a younger age, and suffer more frequently from a PU infection. A shift in the primary cause of mortality associated with SCI changed from infectious diseases to chronic diseases and is a more recent topic for research. Obesity, CVD and sedentary lifestyles contribute greatly to increased morbidity and mortality among persons with an SCI.

Studies have found that PUs is found among those who are obese and who are not highly mobile. In addition, few high-quality studies exist examining quantifiable amounts of nutrients needed to prevent PUs or to optimize the healing process once a PU occurs in the SCI patient.

This study investigated issues of nutrition status of adult SCI persons using a variety of data collection tools including questionnaires, 3-day food logs, and skin assessment.

Chapter III

Conceptual Framework

The International Classification of Functioning Disability and Health (ICF) framework was developed by World Health Organization (WHO) and published in 2001 to provide a complete depiction of the wide spectrum of human functioning (WHO 2002) and is the framework for this research. There are two general conceptual models related to the ICF: the medical model and social model of disability. Concepts of these two models have been joined to form the more comprehensive ICF model. The medical model views disability as a physical condition caused directly by disease, trauma or other co-morbid conditions. As such, the disability requires individual medical attention by a caring professional. Disability, as seen by the medical model, seeks to 'correct' the problem of disability by medical treatment through intervention directed purposefully to the individual (WHO, 2002).

The social model of disability addresses the condition from a socially created view and does not attribute the condition within the context of an individual. From this point of view, the intervention requires action from political arenas as conditions including unaccommodating physical environments influence attitudes and other features, which are at the base of the social environment (WHO, 2002). Although each model offers some degree of strength, neither the medical model nor the social model of disability is adequate on their own, however, by integrating the two models the ICF can be viewed as a "bio-psycho-social model" which carries a large measure of strength (WHO, 2002)

The ICF model is designed for a stronger understanding of human functioning and disability, which is based on a biopsychosocial perspective of health (McDougall, Wright, &

Rosenbaum, 2010). Such a biopsychosocial perspective demonstrates the interactive influences of the physical, psychological and social factors on health. It also illustrates the importance of recognizing the individuals' point of view regarding their own health and well-being (McDougall, Wright, & Rosenbaum, 2010). The wide spectrum of human functioning that encompasses all aspects of health and health-related factors is fully described in the ICF (De Vriendt, Lambert, and Mets, 2009). A unique feature of the ICF model is the use of multiple instruments (ICF checklist, WHODAS 2.0) to evaluate the human function and disability. The ICF model measures disability in the form of codes and classifications using standard language and common conceptual basis (WHO, 2002). This format was developed in an effort to facilitate collaboration across disciplines as it employs a framework or structure for interdisciplinary research in topics of disability and for ensuring results of research that are comparable across disciplines (WHO, 2002). The ICF provides a unified language and framework to describe human functioning and its external environmental influences (WHO, 2002).

There are many uses for the ICF model. The model can be used as a tool for policy and planning by decision makers and it can be used for improving global care for those with a disability. The WHO currently utilizes a multidimensional health measure as the basis for performance assessment of a country's health system. By utilizing the ICF to measure health systems, the WHO can assist member countries to improve their health systems performance (WHO, 2002).

The ICF offers not only an improved classification system, but it offers a conceptual framework of human functioning and disability. In this model (Figure 3.1), functioning is understood to encompass all bodily functions and structures, activities, and participation.

Disability, on the other hand, is viewed as an overarching term for impairments, activity limitations, and participation restrictions. ‘Impairments’ are defined as problems in body function or structure; ‘activity limitations’ are difficulties a person may have in carrying out daily activities; and ‘participation restrictions’ are problems a person may experience when involved in life or social situations (McDougall, Wright, & Rosenbaum, 2010).

Figure 3.1 illustrates how the ICF is formatted; highlighting the interaction between all of its components in both the functioning and the disability status of a person. The ICF uses a classification that provides a neutral framework; it is not limited to those with disabilities. ICF serves as a framework to organize information, giving standard operational definitions, and describing the essential attributes of each health domain. Since the classification is able to describe functioning both at the individual and at the population level it offers a broad range of applications for research. Because of the increasing occurrence of chronic, persistent conditions and illnesses seen in older adults, functioning has become a more central issue in medicine and ICF is growing as a framework to better organize care and research related to chronic conditions.

The ICF Disability and Health model is organized into two parts: 1) "functioning and disability", and 2) "contextual factors" which is illustrated in figure 3.1. Each part is divided in components, respectively "body functions", "body structures", and "activities and participation" (part 1), and "environmental factors" and "personal factors" (part 2). The ICF model is used to categorize health related domains that can affect changes in the body function and structure, a level of capacity, and level of performance.

There are three components in part 1 of the ICF (see Figure 3.1). The first component, body functions and structures, describes physiologic functions and anatomic locations. It also

defines loss or deviations from normal body functions and structures, which are referred to as impairments.

The second component, activity, describes tasks accomplished by the individual; “activity limitations” are defined as problems the individual may have faced in their attempt to complete the activities (“Are you limited in using your telephone, for example, “when calling friends?”). In the “activities and participation" component of part 1 of the ICF, "performance" and "capacity" are clearly distinguished. The performance qualifier describes what an individual does in his or her current environment. The capacity qualifier describes an individual's ability to execute a task or an action, aiming to indicate the highest probable level of functioning that a person may reach in a particular domain. The third component, participation, illustrates involvement in life situations. “Participation restrictions” are those complications, which may be experienced with such activities (“Are you restricted in talking to your friends?”). The three components are listed under the title functioning and disability.

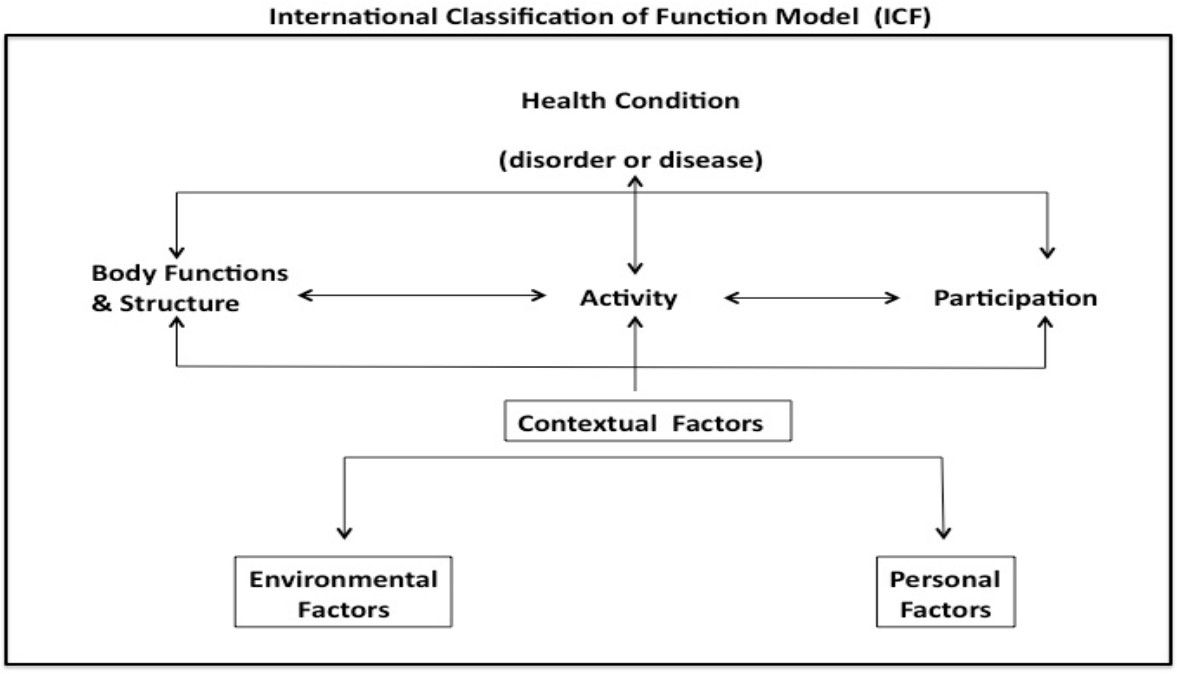
In part 2, the contextual factors, the first component is environmental, and the second component is personal factors. The environment factor is identified widely as physical factors including climate and terrain, social attitudes, institutions and program, and policy/laws. Personal factors are defined as the features of the individual that are not part of a health condition and are handled differently in ICF because of the large variance in social and cultural context. Examples are gender, race, education, profession, and lifestyle.

The ICF can be utilized in health-related research as it offers the researcher a way of considering and examining wellbeing and health related outcomes and determinants when examining any medical related conditions. The techniques for using the ICF are to obtain information through observation, clinical judgment, professional reasoning, and standardized or

non-standardized questionnaires, written material by the individual with the disability, and interviews from the individual or the proxy.

Figure 3.1

ICF Model
Interface Between Concepts World Health Organization (WHO), 2001)



Adapted From: Model of Disability – ICF Model

ICF in Clinical Research

The IFC has been used by other researchers in studies of persons with SCI to describe their health and health related states (Miji, 2004). The successful use of the ICF proved it to be an important tool to identify health functioning and conditions. Vall and colleagues used the ICF model to assess the functionality of 109 persons with traumatic and non-traumatic SCI in Brazil. Researchers administered the ICF to individuals with SCI in order to identify disabilities and limitations related to body functions, activities and participation and environmental factors. The structures and functions of the body and activities were identified and evaluated. In the domain

"Body Functions," there were eight categories evaluated for *"disability"* (energy, sleep, emotion, weight, intestines, bladder, sexuality, & skin). The categories most compromised were intestines and sexuality, qualified as "serious or complete disability." The categories energy, sleep, emotion, weight and bladder were found to be compromised, but qualified as "slight or moderate disability." The skin was the least compromised, as it was qualified as "no disability" (Vall et al., 2011).

In the domain "Activities and Participation," the categories bathing, toilet, dressing, eating, self-care, family relations, and leisure were evaluated for *"difficulty"*. These categories showed "slight or moderate difficulty" to carry out, where no item indicated "serious or complete difficulty." The categories eating and relation with family was qualified as "no difficulty." The item eating can be explained in the same manner (Vall et al., 2011). In the second part, the environmental factors associated with the individual were considered. The study validated the spectrum of constructs of the body, activities and participation, as well as environmental factors in patients with SCI (Vall et al., 2011).

In the domain "Environmental Factors," categories being evaluated as "*barriers or facilitator"* were medications, orthoses, wheelchair, an attitude of family, an attitude of friends, an attitude of authorities, social attitudes, home, transport, social foresight, health, education & work. The categories classified as "facilitator" were: medications, orthoses, wheelchair/crutches, an attitude of family, transportation, social foresight and health services. However, the categories classified as "barrier" were: attitude of authorities, social attitudes, home policies, education and work. The attitudes of friends were classified as "no facilitator or barrier" (Vall et al., 2011). Vall et al. 2011 study validates the concepts of the body, activities and participation, as well as environmental factors in patients with SCI (Vall et al., 2011).

Biering-Sorensen et al. (2006) used the ICF framework to create a core data set for persons with SCI in order to specify functioning. They developed a booklet titled *A Comprehensive ICF Core Data Set* recommended for use in the clinical arena to evaluate the individual's needs, create goals, and evaluate an intervention to assist with communication between health care individuals and the person with SCI (Biering-Sorensen et al., 2006).

De Vriendt, Lambert, and Mets (2009) used ICF in their research to explore the links between the Geriatric Minimum Data Set-25 and ICF and to provide a standardized description of the older person participating in clinical research. The results of their research illustrated the functional aspects (mobility, self-care, domestic life, major life area, products and technology, & support and relationships,) of the Geriatric Minimum Data Set-25 provided the key association (like family support or professional care) with a set of corresponding descriptors (body function, activities and participation, environmental factors and personal factors) from the ICF model. They were also able to conclude the Geriatric Minimum Data Set-25 provides categories to code similar to the ICF model, however this code classification is not the most appropriate instrument to describe the condition of an older person and there is a need for further standardization of the Geriatric Minimum Data Set-25 (De Vriendt, Lambert, & Mets, 2009).

Heinen et al., 2005 study explored systematically the usefulness of the ICF model to nurses providing care. The aim of Heinen and colleagues' study was to demonstrate if there was a link between the ICF and nursing domains (assessment, nursing diagnosis, goals, intervention and evaluation) specifically nursing diagnosis (Heinen et al., 2005). This study was a two-part project and was conducted with 3 hospitals. The results illustrated nurses can take their usual tools such as assessment and transfer forms and design these forms to be incorporated in the ICF classification. Two limitations of this study were; one, converting current nursing diagnoses into

ICF terminology and two, the nursing diagnoses used were from hospital patients only limiting the finding to hospital settings. More meaningful results can be obtained using nurse-diagnosed approaches in outpatient care settings on topics of environmental factors and participation.

ICF Domains Used in Current Research

The ICF model was a valuable tool for use in this study primarily because the ICF domains focus on health as it relates to the variations occurring in the patients' level of capacity and level of performance. Using the ICF as a framework for research offers valuable information regarding the level of functioning for individuals with SCI, and to exhibit the mechanism of change over time with intervention (Boonen, Rasker, & Stucki, 2007). The application of the ICF model for this study is described below and is displayed in Figure 3.2

Health Condition. In this study the health condition studied was pressure ulcers (stage 2-4, unstageable, and DTI).

Body Function and Structures. The concepts of body function and structures for the this study included nutrition status measurements (total score from the Mini Nutritional Assessment (MNA-SF), Macronutrient intake measures included kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber and protein intake measured using a 3-day self-report food log and Micronutrient intake measures included vitamins A, B12, C, D, E, K, folate, and minerals calcium, iron, copper, and zinc measured using a 3-day self-report food log; anthropometric measurements Body Mass Index (BMI), tricep skin fold, and Waist Circumference (WC)); disability status measurement (summary score using simple summation of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 36 questions); the total score from the Spinal Cord

Injury-Secondary Condition Scale (SCI-SCG) and skin assessments using the (Bate-Jensen Wound Assessment Tool (BWAT).

Activity and Participation. The concepts of activities and participation for this study included in-person home interview. Questions were asked to assess the participants' participation in grocery shopping, cooking, preparing their own meals, and outside services used. Examples of questions asked by PI on day one of the study were; do you prepare your own meals, or do you have a caregiver to prepare your meals, 2) do you do your own grocery shopping, and 3) are you currently utilizing outside service such as home health. The ICF model considerers the level of performance of the patient and for this study. Participation was defined by if the patient can get out of bed independently or if assistance is needed.

Environment Factors. The concept of environment factors for this study included aspects affecting health outcomes such as; living arrangement, caregivers, and medication. In this study, environment factors were measured by: in-person home interview on day one of the study by PI. Examples of questions asked on day one of the studies were 1) Do you have a paid caregiver to assist you in your home? 2) Do you have family members living in the home with you? and 3) What medication are you currently taking including over the counter medication and vitamins or herbs?

Personal Factors. The concept of personal factors for this study included gender, race/ethnicity, level of SCI, duration of SCI, age, marital status, education, income, smoking (never, former, or current), bowel and bladder function (incontinent, urinary retention, or indwelling catheter). Personal factors obtained during the in-home interview. Examples of questions asked by PI on day one of the study were; 1) What is you date of birth? 2) What is your marital status? and 3) What is the level of your SCI?

The ICF is a classification that allows for a comprehensive and detailed description of a person's experience of disability, including the environmental barriers (living arrangement and medication) and facilitators (caregivers) that have an impact on a person's functioning. The recognition of the central role played by environmental factors has changed the focus of the problem (SCI, PU) and, hence, focus of intervention from the individual to the environment in which the individual lives. Disability is no longer understood as a feature of the individual, but rather as the outcome of an interaction of the person with a health condition and the environmental factors.

The ICF was useful as the conceptual framework for the current research because it allowed for a comprehensive and detailed description of a person's experience of disability that may impact functioning. The domains of the ICF allowed the examination of specific factors which may affect the nutritional status among community dwelling non-ambulatory persons with a SCI with and without PU's such as; ability to participate in grocery shopping, and meal preparation (Activity & Participation); living arrangement, medication, and caregivers (Environmental Factors); level of SCI, duration of SCI, smoking (never, former, or current), bowel and bladder function (incontinent, urinary retention, or indwelling catheter), age, gender, marital status, education, income, race/ethnicity (Personal Factors).

The ICF allowed for various factors to be considered in the examination of the nutritional status among community dwelling non-ambulatory persons with a SCI with and without PU's. Using the ICF as a framework in this study added to the body of knowledge of nutritional status and PU among individuals with SCI (Figure 3.3).

Summary

The ICF model offered an excellent, scientific tool for the identification and characterization of health conditions and functions that shift the approach from solely the medical model to an integrated biopsychosocial model that is inclusive of human functioning and disability. The ICF provided an exhaustive description of human functioning, encompassing all aspects of health and health-related factors. It is looking beyond disease and mortality (De Vriendt, Lambert, & Mets, 2009). The ICF is a valuable tool that can be used in research that assesses disability, in all its dimensions, i.e. Impairments of the body at all levels, person-level activity and limitations, and restrictions at the societal level of an individual or group participation. ICF is particularly useful because of its multi-level organization (De Vriendt, Lambert, & Mets, 2009). One has the possibility to use only the general levels for a global description of functions or to choose the more detailed coding of specific categories, using the fourth level. ICF also provides the tool to assess the social and environment context of individuals with a disability. The ICF model can assess all persons with all forms of disabilities, identifying their health care and rehabilitative needs, as well as identifying and measuring the physical and social environment needs. The ICF is recognized worldwide and offers a common language and approach useful in research, facilitating research more compatible and exchangeable (De Vriendt, Lambert, & Mets, 2009).

Figure 3.2 International Classification of Functioning, Disability and Health (ICF)

Current Research

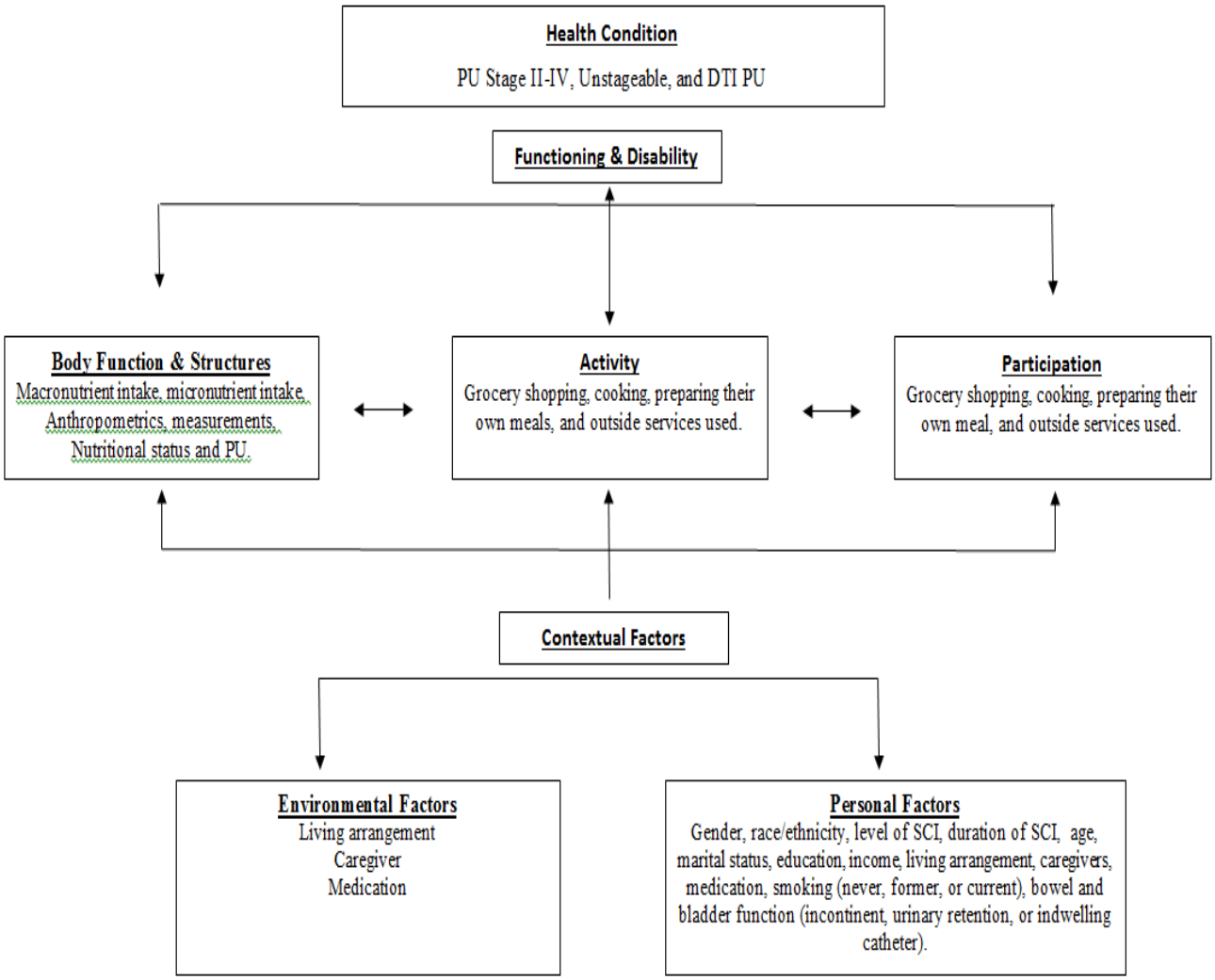
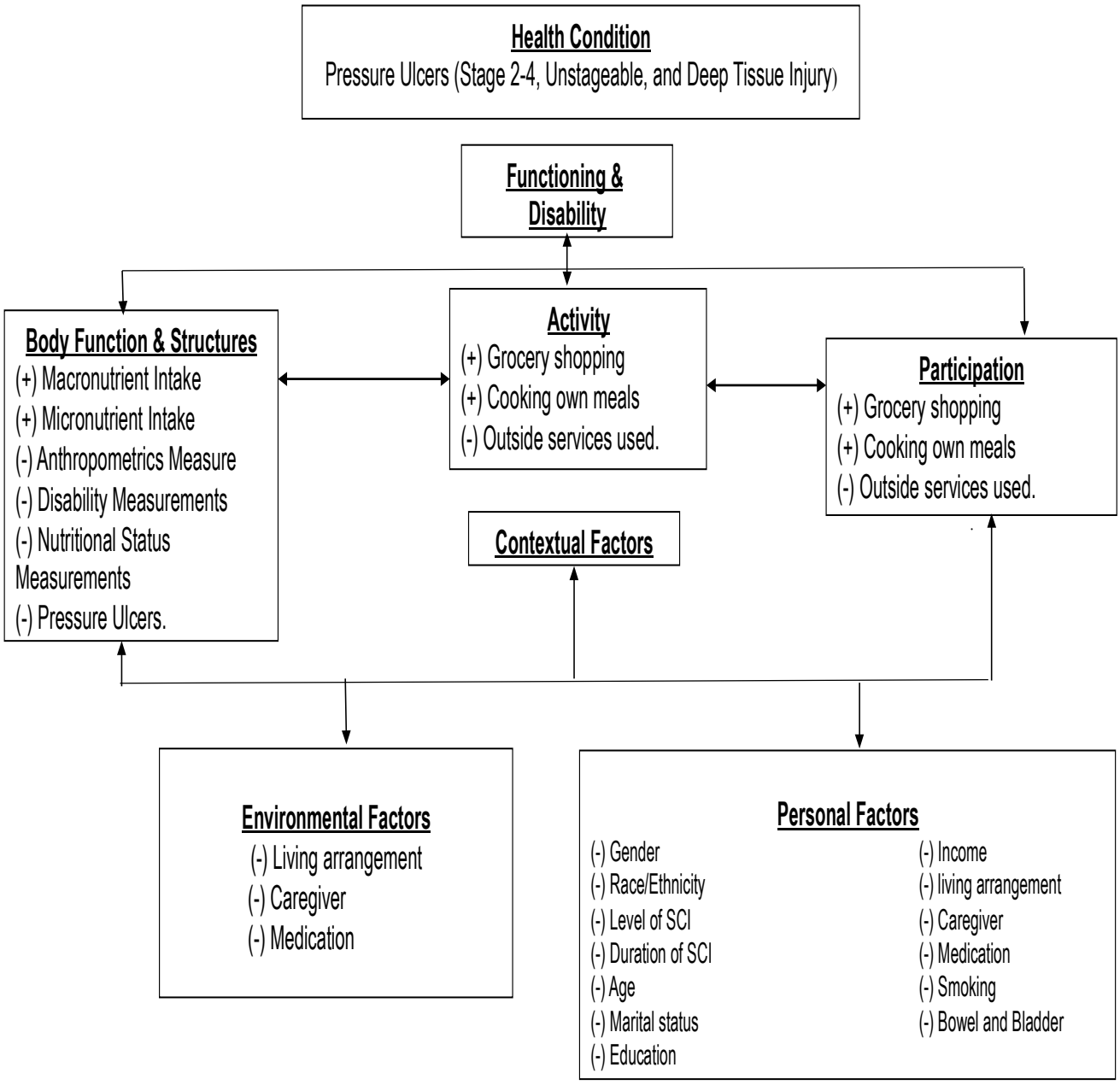


Figure 3.3 International Classification of Functioning, Disability and Health (ICF)
Outcome of Current Research



Chapter IV

Methodology

Introduction

Increasing survival rates for Spinal Cord Injury (SCI) have been reported over the last 30 years primarily as a result of advancement in medical care, particularly in the area of acute medical intervention (National Institute of Neurological Disorders and Stroke (NINDS, 2015). As a result, individuals with SCI are more prone to present with chronic diseases, such as type 2 diabetes and cardiovascular disease (CVD). Increased risks for these chronic diseases are thought to be due to poor nutrition and lack of physical activities (Khalil, Gorgey, Janisko, Dolbow, Moore, & Gater, 2013).

Individuals with SCI may reside in a community living situation where physical activity is very minimal primarily due to mobility problems, lack of assistance and attention, and caregiver shortage (Emerich, Parsons, & Stein 2012). Resources, such as psychosocial information and support may also be lacking or non-existent due to various constraints (Peter, Muller, Cieza, & Geyh, 2012). The lack of physical activity, coupled with chronic diseases and poor nutrition, can result in a greater risk for the development of pressure ulcer (PU).

Examining the nutritional status among community dwelling non-ambulatory persons with a SCI with and without PU's has provided much needed information on the needs of this vulnerable group. This study explored the relationship between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, disability measurements, and nutrition status measurements observed among community dwelling non-

ambulatory persons with a SCI with and without PU's. The specific aims and research questions are:

Aim 1: Describe nutritional intake of macronutrients and micronutrients among community dwelling non-ambulatory person with a SCI with and without PU's.

The operational definition of macronutrient intake will include kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat (omegas 3 and 6), cholesterol, fiber and protein intake measured using a 3-day self-report food log. Micronutrient intake measures include vitamins A, B12, C, D, E, K, folate, and minerals calcium, iron, copper, and zinc measured using a 3-day self-report food log.

Research Question 1A: Is there a relationship between macronutrients intake and micronutrients intake among community dwelling non-ambulatory person with a SCI with and without a PU's?

Research Question 1B: Is there a difference in macronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU's?

Research Question 1C: Is there a difference in micronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU's?

Aim 2: Describe and evaluate the relationship of psycho-social factors, anthropometric measurements, nutrition status measurement, and disability status measurements among community dwelling non-ambulatory person with a SCI with and without a PU's

Psycho-social factors will include gender, race/ethnicity, level of SCI, duration of SCI, age, marital status, education, income, living arrangement, caregivers, grocery shopping, cooking, outside services used, medication, smoking (never, former, or current), and bowel & bladder function (incontinent, urinary retention, or indwelling catheter). Anthropometric measurements

include: Body Mass Index (BMI), Tricep Skin Fold, and Waist Circumference (WC). Nutrition status measurements include: Total score from the Mini Nutritional Assessment (MNA-SF; 2). Disability Status Measurements includes 1) summary score using simple summation of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 36 questions; and 2) total score from the Spinal Cord Injury-Secondary Condition Scale (SCI-SCG) total score.

Research question 2A: What is the relationship between psycho-social factors, anthropometric measurements, nutrition status measurement, disability status among community dwelling non-ambulatory person with a SCI with and without a PU's?

Research Question 2B: Is there a difference in psychosocial factors among community dwelling non-ambulatory person with a SCI with and without a PU's?

Research Question 2C: Is there a difference in anthropometric measures among community dwelling non-ambulatory person with a SCI with and without a PU's?

Research Question 2D: Is there a difference in nutrition status measurement (Total MNA Score) among community dwelling non- ambulatory person with a SCI with and without a PU's?

Aim 3: Describe and evaluate the correlation among macronutrients intake, micronutrients intake, anthropometric measurements, psycho-social factors, nutrition status measurements, and disability status measurements among community dwelling non-ambulatory person with a SCI with a Partial Thickness PU (Stage 2 PU) versus Full Thickness PU (Stage 3, 4, or Unstageable PU).

Macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, disability status measurement, and nutrition status measurement was same as defined in

specific aim 1 and specific aim 2. Pressure ulcers stages 2, 3, 4, or unstageable are defined according to the 2014 NPUAP staging system and shown in Table 1.1 (NPUAP 2014).

Research question 3A: What is the relationship among macronutrient intake, micronutrient intake among community dwelling non-ambulatory person with a SCI with a partial thickness PU versus full thickness PU?

Research Question 3B: Is there a difference between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, and disability status measurements among community dwelling non-ambulatory persons with an SCI with a partial thickness PU versus full thickness PU?

Research Question 3C: Is there a difference in nutritional status (Total MNA Scores) among community dwelling non-ambulatory person with an SCI with a partial thickness PU versus full thickness PU?

Research Design

The research design was a descriptive cross-sectional study designed to characterize the nutritional status and the relationship between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, disability status measurements, and nutritional status measurements among community dwelling non-ambulatory persons with a SCI with and without PU's. The study projected was conducted within a 12-24-month timeframe, and 121 participants were recruited, and 80 participants were enrolled taking into consideration potential attrition.

Data was collected using structured questionnaires, nutritional assessment tools, skin assessment, and anthropometric measurement. Data was gathered over a four-day period consisting of two home visits, one initial visit and a second visit on day four. Follow-up phone

calls occurred on the second and third day of the study for retention and for completion of the data gathering tasks.

Macronutrient intake and micronutrient intake data was collected using a 3-day food log given to participants on day one of the study.

Anthropometric measurements included self-reported height and weight, Tricep Skin Fold average, and Waist Circumference (WC). Height and weight were used to calculate participants' BMI using guidelines from Center for Disease Control and Prevention (CDC). The Primary Investigator (PI) obtained anthropometric measures on day one of the study.

Psycho-social factors include gender, race/ethnicity, durational of SCI, level of SCI, age, marital status, educational level, income, living arrangement, caregivers, grocery shopping, cooking, outside service use. All psycho-social factor items were measured via structured questionnaire and was administered by PI during the initial home visit on day one of the study.

Disability status include 1) summary score using simple summation of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) 36 questions; and 2) total score from the Spinal Cord Injury-Secondary Condition Scale (SCI-SCG).

Nutritional status measurements include the MNA®-SF to be administered by PI on the initial home visit on day one of the study.

Sample Setting

Study participants were recruited from five home health agencies and three SCI rehabilitation facilities located within Southern California. Each home health agency serves on average three to five individuals with SCI per month with one or two reporting a PU. SCI centers invited to participate in the study include:

(1) Rancho Los Amigos National Rehabilitation Center, which is licensed for 395 beds and provides care for over 4,000 inpatients and provides 78,000 outpatient visits each year;

(2) Northridge Medical Hospital, an outpatient SCI Program which prepares patients to return home and provides ongoing support for life time care; and

(3) Casa Colina Hospital and Centers for Healthcare, an acute care hospital licensed for 68 beds which offers inpatient rehabilitation and a state-of-the-art outpatient center serving over 10,000 patients per year in areas of orthopedic, neurologic, speech, hand, sport, aquatic therapies, and advanced audiology.

A statistical power analysis conducted on the proposed study design and anticipated participants indicate that a sample size of 80 subjects would allow detection of a medium (0.688) effect size, with power at 80 percent (alpha = 0.05, two tailed), based on similar studies by Knight, Buchholz, Martin Ginis, and Goy (2011) and Guihan and Bombardier (2012). Accounting for 20 percent attrition, 121 participants were recruited to ensure the required sample of 80 participants (40 participants with PUs and 40 participants without PUs) for each group. Based on three to four SCI patients per month in Home Health agencies and 10 to 20 per month in the rehabilitation facility, it was estimated two to six patients per week will be recruited and data collection would be completed in 12 to 24 months. Therefore, the goal was to recruit at least 100 community individuals with a SCI to ensure a sufficient number of participants (N=80) to complete the study.

The study participants were recruited using flyers posted at (1) home health agencies and SCI centers, (2) local churches, (3) SCI support group meetings within the community, (4) local YMCAs, and (5) local gyms. The flyers announced the study, list the inclusion eligibility criteria,

and provided contact information (number and name) so that potential participants can take the steps necessary to enroll in the study.

Inclusion criteria

Study inclusion criteria included: (1) adults aged 21 years and older, (2) diagnosed medically with a SCI, (3) 12 months or more duration of a SCI, (4) access to a telephone for follow up contacts, (5) ability to write and speak English, and (6) reside within the Southern California.

Exclusion criteria

Exclusion criteria for this study included the inability to communicate or to fully participate in the study and include individuals: (1) with a communication disability such as inability to hear or speak, (2) diagnosed with mental illness such as schizophrenia and active psychoses, (3) ambulatory SCI and (4) inability to write and speak English. These exclusions were necessary due to the need for participants to fully participate in telephone conversations and directions and because the study is focused on non-ambulatory persons with SCI because these individuals are at increased risk for PU development.

Instruments

Data collection instruments for this study included measures that were collected by interview, anthropometric tools, self-report food logs, and psycho-social factors:

- Nutritional assessment tools will be the MNA®-SF and Food Frequency Questionnaire (FFQ)
- In-home Interview

- WHODAS 2.0 (Structured checklist 36 questions)
- Self-report 3-day food log
- Anthropometrics tools (skin calipers, flexible tape measure in centimeters)
- SCI-SCS (16 questions)
- Physical skin assessment including NPUAP/EPUAP (2014) guidelines for PU staging classification, and the Bates-Jensen Wound Assessment Tool (BWAT) for existing PUs.

Demographic and medical data was collected using self-reports from the patient. Nutrition questionnaire include MNA®-SF. The 3-day food log was self-reported. Anthropometric measurements include the BMI, Tricep and WC. Each instrument is described in detail below.

Nutritional Assessment Tools

Mini Nutritional Assessment Short Form (MNA®-SF)

The full MNA® was developed to provide a simple, reliable way to screen nutritional status for persons 65 years of age and older and to add a nutrition component to the Comprehensive Geriatric Assessment. The Mini Nutritional Assessment Short Form (MNA®-SF) was adapted from the original 18-item Mini Nutrition Assessment (MNA®) tool (Guigoz et al., 2002), which evaluated dietary, anthropometric, global and self-perceived aspects of nutrition. The MNA®-SF tool (see Table 4:1) is a 6-item questionnaire developed by Kaiser and colleagues (2009) to assess anthropometric measurement (BMI and weight loss), global assessment (intestinal motility), dietary questions (food intake), and health assessment (acute diseases and neurological problems) (DiMaria-Ghalili & Amella, 2012). An example question item for the MNA®-SF is, “has food intake declined over the past 3 months due to loss of appetite, digestion problems, chewing, or swallowing difficulties?” The MNA®-SF evaluates

individuals who may be at risk for undernutrition (DiMaria-Ghalili & Amella, 2012). Identified undernutrition can further be assessed using the 12 additional questions from the MNA® to confirm diagnosis as it relates to undernutrition.

The full MNA® has been validated in many research studies with older adults in hospital, nursing home, ambulatory care, and community settings (Mueller, Compher, Ellen, 2011, Guigoz, Lauque & Vellas, 2002; Guigoz, Jensen, Thomas, & Vellas, 2006). Bastiaanse and colleagues (2012) conducted research with 48 persons age 50 years and older having a range of borderline to profound intellectual disabilities to examine the MNA® in this population. Participants were administered the MNA® using in-person interview by trained research staff. Both test-retest reliability and interrater reliability for caregivers were excellent and the internal consistency was substantial with a Cronbach's alpha = 0.71. In a sample of 174 elderly residents in long-term care, Malara and colleagues (2014) used the MNA® to investigate the relationship between cognitive deficit and nutritional state and between functional state and the burden of assistance. MNA® was administered by interview by the trained researcher. Results demonstrated a significant relationship between MNA® and Mini Mental State Examination (r=0.39; P<.001). Christensson, Unosson, & Ek (2002) evaluated the MNA® regarding its validity by using a combination of anthropometric and serum-protein measurements as standard criteria for comparison to MNA® results. They assessed the protein-energy malnutrition (PEM) in 161 elderly residents living in the community and found that the sensitivity and specificity in detecting PEM in MNA® was 0.96 and 0.26, respectively. These results demonstrated that the MNA® is a useful tool in detecting residents who need preventive nutritional measures (Christensson, Unosson, & Ek, 2002).

The MNA®-SF was developed from the full MNA®, the reliability of the MNA®-SF is has not been reported (Skates & Anthony, 2012), however the MNA®-SF has been compared to the full MNA®, for validity testing in multiple studies (Lee et al., 2012, Rubenstein et al., 2001, and Kaiser et al., 2009) and the validity testing is described below.

Lee and colleagues (2012) examined the functional status-predictive ability of the MNA® by comparing the ability of two adapted versions of the full MNA® in predicting the functional ability of 2948 elderly Taiwanese. With both the MNA®-SF and the MNA® a greater proportion of participants were identified as being at risk of undernutrition according to the MNA®-SF as compared with the full MNA®. Rubenstein and colleagues (Rubenstein et al., 2001) used the MNA®-SF and full MNA® to predict undernutrition among community dwelling adults and found a 90 percent agreement between the MNA®-SF and the full MNA®. Rubenstein, Harker, Salva, Guigoz & Vellas (2001) reported 97.9 percent sensitivity, 100 percent specificity, and 98.7 percent diagnostic accuracy in predicting undernutrition using the MNA®-SF in community dwelling adults (Rubenstein et al., 2001). Similarly, Kaiser and colleagues (2009) showed a strong positive predictive value, Youden Index = 0.70, when the full MNA was used to examine undernutrition among elderly participants (Kaiser et al., 2009). Youden is the maximum potential effectiveness of a biomarker and is a common summary measure of the receiver operating characteristic (ROC) curve. The ROC curve is used to evaluate a biomarker's ability for classifying disease status (Ruopp, Neil, Whitcomb, & Schisterman, 2008). Kaiser and colleagues suggest that as a result of the high predictive value with the full MNA scale, the MNA®-SF can function as a stand-alone tool (Kaiser, Bauer, Ramsch, Uter, Guigoz, Cederholm, & Thomas, 2009).

The MNA®-SF was administered to study participants on day one of the study by the PI. The MNA®-SF was administered as the second of the assessments which was completed on day one and took about five minutes to complete.

Food Frequency Questionnaire (FFQ)

The development and validation of the FFQ is a complicated process. The FFQ used for this study is the "Block" FFQ, which was adapted from the Full Block FFQ (FBFFQ). The FBFFQ was derived from a larger food frequency tool developed and used by Block and colleagues in 1990. The FBFFQ consists of 110 questions about specific foods and beverages consumed and include additional questions related to fat, protein, carbohydrate, sugar, and whole grain content of foods.

Block and colleagues (1986) developed dietary analysis software for the Health Habits and History Questionnaire (HHHQ) (quantitative food frequency questionnaire) and the FBFFQ by modifying and adapting the more detailed FFQ from dietary data from 11,658 adult respondents. They found that the FBFFQ food list when used to calculate nutrients from a 24-hour dietary recall showed Pearson correlation coefficients $r > 0.70$ with the more detailed FFQ method (Block et al., 1986).

Used in two of the National Health and Nutrition Examination Surveys dietary recall data (2007-2008 and 2009-2010), the SBFFQ was developed from the USDA's Food and Nutrient Database for Dietary Studies, the Food Pyramid Equivalents Database, and the Nutrient Database for Standard Reference. The SBFFQ also measures activities (developed from the National Human Activities Patterns Survey) as a screening tool and includes 11 items of the most important sources of energy. The activity screen estimates minutes, metabolic equivalent of task

minutes, and kilocalorie expenditure from several activity types. Portion size pictures are attached to the questionnaire and included to help to measure portion sizes

In 1994, Block and colleagues revised the dietary analysis software for the (HHHQ) questionnaire for the use with the SBFFQ. The HHHQ software facilitates the collection of 33 major nutrients (energy, protein, carbohydrates, total fat, percent of energy, cholesterol, saturated fat, oleic acid, linoleic acid, supplements, etc.) as predictors of morbidity and mortality, (non-dietary, as well as dietary), in a standardized manner (Block 1994). Additionally, the revised version of the HHHQ simplifies the data and verification of questionnaire data preventing duplication. Block and colleagues used the same identical reference data and questionnaire responses from previous published data using the original HHHQ software (Women's Health Trial Feasibility Study,) to test the revised version of the HHHQ software and compared findings with the revised HHHQ software to the original HHHQ software finding (Block, 1994). Pearson product moment correlations showed a relationship between the (HHHQ) nutrient estimates and the mean of three 4-day records from 1015 women between the ages of 45 to 70 years of age, and results from protein intake yielded a result of 0.48 with previous dietary analysis software and 0.50 with revised dietary analysis software. Total fat intake result was 0.60 with the previous dietary analysis software and 0.59 in the revised version of the dietary analysis software. The revised dietary analysis software demonstrated minimum difference in the previous software validating the use of the software. The revised software made the use of HHHQ more user friendly, facilitated the use of standard or investigator designed questionnaires, and provided a broad coverage dietary assessment instrument that would permit investigations to include dietary factors in their studies at minimal cost (Block, 1994).

Block, Woods, Potosky and Clifford (1990) developed a short version of their FBFFQ called the "Block" FFQ, using a self-administered diet history questionnaire with multiple diet records from 260 women between 45 to70 years of age. Block and colleagues demonstrated a correlation between the "Block" FFQ and the original FBFFQ when it was used to rate the mean of the 4-day diet records with Pearson correlation coefficients ranging from $r = 0.47$ to $r = 0.67$ in the usual diet group, and in the low fat group, $r = 0.37$ to $r = 0.66$ with the average correlation between the "Block" FFQ and FBFFQ of about r=0.55 in both groups.

Mares-Perlman, Klein, Klein, Ritter, Fisher, and Freudenheim (1993) administered the "Block" FFQ to 211 community dwelling middle aged and older adults. They found the "Block" FFQ demonstrated estimates from the questionnaire and records resulted in correlation coefficients were generally > 0.5, indicating overall good agreement in ranking.

The "Block" FFQ is being increasingly utilized as a valid method for assessing diet in epidemiological studies. It is a relatively inexpensive assessment tool and is found to be more accessible than other dietary tools (Broadfield, McKeever, Fogarty, & Britton, 2003). The "Block" FFQ tool was the third of the assessments completed on day one by the PI. It took 45 minutes to complete the "Block" FFQ.

Food Log

Dietary logs have been used in various ways and have proved useful in determining proportion of energy consumed in the American diet (Drewnowski & Rehm, 2013). George and colleagues (2004) used a 3-day log record to validate a multicultural food frequency questionnaire for young women in the southwestern United States. George et al. (2004) studied 95 college women and 50 low income postpartum women and demonstrated nutrient means from

the recalls and diet records were correlated significantly with each other ($p<.01$); correlations exceeded 0.5 for total calories, protein, dietary fiber, vitamin C, calcium, iron and magnesium.

Liu, Wang, Roebothan, Ryan, Tucker, and Colbourne et al. (2013) research aim was to address whether a self-administered FFQ to 195 adults was valid in the Newfoundland general adult population by comparing results of multiple 24-hour dietary recalls. The 24- hour dietary recalls were unannounced and conducted by telephone by trained interviewers. Results demonstrated Pearson correlation coefficients for each nutrient varied from 0.13 to 0.61. Except for protein in men, all correlations were statistically significant with $p < .05$.

Ye, Scott, Gao, Maras, Bakun & Tucker's (2013) research aim was to examine associations between diet quality, as assessed by the Mediterranean diet and Heathy Eating Index 2005 and cognitive function measured by the Mini Mental Status Examination. Ye and colleagues measured cognitive performance in a sample of 1,269 Puerto Rican adults aged 45 to 75 years old using the FFQ. The FFQ was administered during a home interview by a trained research staff to assess dietary intake for the last 12 months. Results demonstrated the Mediterranean diet was associated with higher Mini Mental State Examination scores ($P<.001$).

Dorman (2013) assessed the reliability of manual data entry for home-packed food items by using digital photographs and dietary log sheets from 60 students in grades three to six. The results demonstrated that the inter-rater reliability intraclass correlation coefficient (ICC) was 0.83 for total kilocalories and ranged from 0.75–0.87 for macronutrients. The intra-rater reliability ICC was 0.92 for total kcal and ranged from 0.90–0.92 for macronutrients. The inter-rater ICCs for the 5 selected micronutrients ranged from 0.33–0.83, whereas the intra-rater ICCs for these micronutrients ranged from 0.65–0.98.

The American Heart Association food log was used for this measure and a sample is listed in Table 4.5. The PI entered the data into a statistical nutrition analysis software program (Elizabeth Stewart Hands and Associates) (ESHA).

Psycho-Social Measure

In-Home Interview Questionnaire:

An in-person home interview were administered to participants that includes eight questions developed by the PI, additional questions on caregivers and meals adapted from Soini and colleagues (Soini, Routasalo & Lagstron, 2004), and more questions related to physiological dietary factors (chewing, swallowing) from Sabour and colleagues (Sabour, Javidan, Vafa, Shidfar, Nazari, Saberi, & Razavi, 2012) and Satia et al (Satia, Galanko, & Siega-Riz, 2004).

- Gender—male, female;
- Race/ethnicity—African American, Asian American, Caucasian, Hispanic, other;
- Level of spinal cord injury-
- Duration of spinal cord injury-
- Age-self report birthday
- Marital status- never married, married/living with partner, divorced/separated/widowed;
- Education-- less than or equivalent to high school, some college, college graduate, advanced degree.
- Income-$0.00-30,000.00, 30,001.00-60,000.00, over 60,001.00

5 questions adapted from Soini, Routasalo, & Lagstron, 2004 including:

- Living arrangement—alone, with spouse/partner, with family, nursing home, assisted living
- Caregivers—paid caregiver, family member, no routine caregiver, friend, in assisted living/nursing home
- Grocery shopping—delivered goes with friend, goes with family, friend/family goes alone, caregiver goes, in facility/NA, etc.
- Cooking—prepares own meals, caregiver prepares meals, family member prepares meals, organization/facility prepares meals, has meals delivered, etc.
- Outside services used—food bank, meals on wheels etc.

Three questions by self- report about medication, smoking (never, former, or current), bowel & bladder function (incontinent, urinary retention, or indwelling catheter) (Sabour, Javidan, Vafa, Shidfar, Nazari, Saberi, & Razavi, 2012; Satia, Galanko, & Siega-Riz, 2004). The in-home interview was administered on day one of the study by PI and it took 10 minutes to complete during the in-home interview.

Disability Status Tools

WHODAS 2.0 Checklist

The World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0), a 36- item checklist tool, was administered by the PI on day one of the study. The tool is used to assess behavioral limitation and restriction experienced by an individual independently from the medical diagnosis (SCI, PU). This tool was developed by World Health Organization (WHO) and is designed to evaluate six domains. The domains are:

1. Understanding and communicating (6 items)

2. Getting around (5 items)

3. Self-care (4 items)

4. Getting along with people (5 items)

5. Life activities (8 items)

6. Participation in society (8 items)

Participants were asked to consider each question pertaining to their last 30 days. They were asked to consider their normal routines and how they normally perform the activities – whether or not they needed assistance or support from a caregiver or another helper in the last 30 days.

- For every item receiving a positive answer, the follow-up questions asks the number of days; (Only one day, up to a week (= from 2 to 7 days), up to two weeks (= from 8 to 14 days), more than two weeks (= from 15 to 29 days), every day (= 30 days)), "in the last 30 days" in which the participant has met such a difficulty. Each item is measured on a 5-point ordinal scale where “1” indicates no difficulties and “5” indicates extreme difficulty or inability to perform the activity. Total summary scores range between 0 and 100, with higher scores reflecting greater disability.

The participant was then asked how much the difficulties have interfered with his/her life. Participants answer the questions according to the following references:

- Degree of difficulty (the increase in the effort, discomfort or pain, or slowness, or differences in general)
- Health conditions (disease or illness, or injury, or mental or emotional problems, or related to alcohol, or problems associated with drug abuse)

- The last 30 days
- The average between good and bad days
- The way in which they normally perform the activity

Items that refer to activities not experienced in the last 30 days are not classified (Federici & Meloni, 2010).

The WHODAS 2.0 tool (Table 4:4) has been used in research investigating the correlation between the six domains mentioned above. Multiple investigators (Alexopoulos et al., 2003; Banerjee et al., 2008; Chwastiak & Von, 2003; Karsten et al., 2010; Kemmler et al., 2003; Kessler et al., 2003; Kim et al., 2005; Luciano et al., 2010; Luciano et al., 2010c; McKibbin et al., 2004; Schippers et al., 2010; Scott et al., 2006; Scott et al., 2009; Von Korff et al., 2005; Wang et al. 2006; Yoon et al. 2004) have used the WHODAS 2.0 tool to measure depression.

Magistrale and colleagues (2014) administered the WHODAS 2.0 to 136 patients with multiple sclerosis and demonstrated excellent reliability according to classical test theory for most of the subscales, and for the total (r=0.93) the "activities" (r=0.88) and "participation" (r=0.92) components showed excellent reliability. Cronbach's alpha internal consistency varied between 0.68 and 0.96 for the six subscales of the WHODAS-2.

De Wolf, Tate, Lannin, Middleton, Lane-Brown, et al. (2012) studied 63 people with traumatic SCI to evaluate the reliability and validity of WHODAS 2 within the SCI population. Results demonstrated a trend for the domain 'life activities' (Mann-Whitney U statistic test $p = 0.059$), which was confirmed as statistically significant using parametric equivalent t-test (mean difference = –17.8; 95% confidence interval (CI) –34.6 to –1.1; $p = 0.037$). The Rasch analysis produced a person reliability coefficient of 0.94, an indication that the items work well together

to consistently reproduce a participant's score. Cronbach's alpha coefficients ranged from 0.61 (getting around) to 0.97 (participation). These results demonstrate preliminary support for reliability and validity of the WHODAS 2.0 in the SCI population.

Ustun and colleagues (2010) demonstrated test-retest reliability of the WHODAS 2.0 through repeated application to over 65, 000 respondents drawn from the general population and from specific patient populations who were interviewed by trained interviewers. Cronbach's alpha coefficient for the different domains was as follows: cognition (6 items), 0.86; mobility (5 items), 0.90; self-care (4 items), 0.79; getting along (5 items), 0.84; life activities for home (4 items), 0.98; life activities for work (4 items), 0.96; and participation in society (8 items), 0.84.

The WHODAS 2.0 tool has demonstrated convergent validity (a subtype of construct validity) when used with populations with chronic diseases to investigate the relationship among impairment, activity limitations, and participation in back pain and depression disorders (Chwastiak & Von Korff, 2003; Schieir et al., 2008; and Garin, Ayuso-Mateos, Almansa, Nieto, Chatterji, & Racca, 2010). Test of convergent validity of the WHODAS 2.0 produced moderate to large correlations between the WHODAS 2.0 and the SF-36 and also between the WHODAS 2.0 and the symptoms measured with the PHQ and the SF-36. In addition, the WHODAS 2.0 facilitates the use of International Classification of Functioning (ICF) as a conceptual framework for the assessment of the limitations in activity and participation, and effectively discriminates between normal/healthy and disabled/sick individuals (Ertugrul & Ulug, 2004). Results from the above study demonstrated means were statistically significantly ($P<.001$) different across time for all of the WHODAS 2.0 subscales except self-care and physical mobility. In addition, the WHODAS 2.0 facilitates the use of International Classification of Functioning (ICF) as a conceptual framework for the assessment of the limitations in activity and participation, and

effectively discriminates between normal/healthy and disabled/sick individuals (Ertugrul & Ulug, 2004). The PI administered the WHODAS 2.0 on day one of the study and it took about 15 minutes to complete the in-home interview.

Spinal Cord Injury-Secondary Condition Scale (SCI-SCS)

The Spinal Cord Injury-Secondary Condition Scale is a 16-item validated tool specifically designed to target secondary conditions associated with SCI that directly and indirectly impact health and physical functioning (Kalpakjian, Scelza, Forchheimer, & Toussaint, 2007). The tool utilizes a 4-point ordinal scale ranging from 0 (not experienced/insignificant problem never limiting activity) to 3 (significant/chronic problem). Summing the item scores with a possible score of 48 derives the total score. A higher score indicates more severe secondary conditions compared with a lower score (Arora, Harvey, Lavrencic, Bowden, Nier et al., 2015).

Kalpakjian, Scelza, Forchheimer, & Toussaint (2007) examined the SCI-SCS in 65 SCI participants over a two-year period. The SCI-SCS was administered at five different time-points along with the Seekins Secondary Conditions Questionnaire (SCQ) (SF-12) to test validity and reliability. The internal consistency was reported to be adequate to excellent at each of the measurement intervals (Cronbach's alphas ranged from =0.76 – 0.86). The test-retest reliability values were also reported as adequate to excellent with correlation coefficients ranging from r=0.56 - 0.80 for each of the time points (Kalpakjian, Scelza, Forchheimer, & Toussaint, 2007). The SCI-SCS total score was highly correlated with the 6-physical functioning-items of the SF-12, with Spearman's ρ values ranging from 0.32 to 0.64 (Kalpakjian et al., 2007). The SCI-SCS tool has demonstrated validity from multiple researchers as a reliable tool in the SCI population.

Arora and colleagues (2015) research study on determining the inter-rater reliability and validity of using a telephone-based version of the SCI–SCS with 40 SCI patients demonstrating an intraclass correlation coefficient and 95% confidence interval of (0.96-0.98) reflects the agreement between the telephone-based versions of the SCI–SCS administered on two different days. The SCI -SCS and instruction on how to use the scale are provided in Table 4.11. The PI administered the SCI-SCS during the home visits on day one of the study and is took about 10 minutes to complete.

Anthropometric Measures

Three measures were collected and used to assess body type and nutritional status: BMI, Tricep Skin Fold, and WC. Collecting data on anthropometry provides much needed and reliable data useful to assess the health and nutritional status of participants (Ahluwalia, Dwyer, Terry, Moshfegh, & Johnson, 2016). The collection approach for these anthropometric measurements is non-invasive and inexpensive (WHO, 1995). The PI administered the three measurements to participants on day one of the study. Each of the three measurements are described further below.

Body Mass Index (BMI)

According to Groah and colleagues (2009), the BMI can be used to quantify body composition in addition to estimating the risk for malnutrition and chronic disease. Self-reported height and weight by participants was collected via interview by PI during the home visit on day one of the study. In a research study by Nakamura, Hoshino, Kodama, and Yamamoto (1999), 462 women showed a high correlation between self-reported height and weight compared to actual height and weight measured values. The correlation coefficients for height and weight were 0·990 and 0·963 ($p<.0001$).

Kuczmarski, Kuczmarski, & Najjar (2001) studied the effect of age on the validity of self-reported height, weight, and BMI in 7,772 men and 8,801 women age 20 years and older. Pearson correlation coefficients between measured and self-reported heights were significant ($p < .001$) for all of age groups within each gender. The BMI values derived from measured weight and height and self-reported weight and height were highly correlated (r=0.89 to r=0.97), and all Pearson correlation coefficients were statistically significant ($p < .001$).

Body mass was determined according to a standard formula used by the CDC and shown in Table 4.6 (CDC, 2015). Interpretation of BMI results followed the CDC guidelines as outlined in Table 4.7 (CDC, 2015). The BMI does not distinguish fat from fat free tissue; however, it is an indicator of risk for type 2 diabetes and CVD (Tirosh, Shai, Afek, Dubnov-Raz, Ayalon, & Gordon, 2011; Brambilla, Bedogni, Heo, & Pietrobelli, 2013). The BMI has been well documented as an inexpensive measurement that is derived from non-invasive measurements that are recorded routinely in clinical and research settings (Must & Anderson, 2006). The BMI is a mathematical computation and will not utilize participant time.

Corrected Arm Muscle Area (CAMA)

Investigators have found the use of CAMA as a nutrition screening tool can determine severe wasting malnutrition and is an indicator of the protein content and mass of muscle (Frisancho, 1993; Harris & Haboubi, 2005; Isenring et al., 2011). Using a Harpenden Skinfold Caliper and the participant's dominant arm was raised at shoulder level with the elbow bent, the triceps skinfold was measured at the midway point between the elbow and axilla. Three consecutive readings were obtained, and the average calculated. Following the triceps skinfold measurements, three mid arm circumference measurements were obtained with the dominant arm

straight and at the participant's side and measured at the midway point between the elbow and shoulder using a flexible centimeter measuring tape. Three consecutive measurements were taken, and the average calculated. To calculate CAMA, arm muscle circumference is first determined using the standard formula as follow:

Arm Circumference (AC) – Tricep skin fold (TSF) = Mid Arm Circumference (MAC)

Next, CAMA is calculated as follows:

$$\text{CAMA } cm^2 = \text{AMC } (cm)^2 / 4\pi - 10 \text{ (men).}$$

$$\text{CAMA } cm^2 = \text{AMC } (cm)^2 / 4\pi - 6.5 \text{ (women)}$$

CAMA measurements will be categorized according to the above cut-off values proposed by DeHollander, Bemelmans, & DeGroot (2013).

Miller and colleagues (2002) were able to demonstrate that CAMA can be an independent predictor of long-term mortality in 1,396 community-dwelling adults. Male participants with a CAMA reading of $\leq 21.4cm^2$ and women participants with a CAMA reading $\leq 21.6cm^2$ had an increased risk of mortality at 8-years follow-up (hazard ratio = 1.94, 95% confidence interval = 1.25-3.00, p=.003).

Arm circumference measurement is simple, requires little training, and is easy to acquire even in bedridden subjects (Gueresi, Miglio, Cavenini, & Russo, 2014). Lastly, the PI conducted all measurements during the home visit on day one of the study and it took about 5-10 minutes to complete the CAMA.

Waist circumference (WC)

Measuring waist circumference (WC) provides a marker for adiposity-related morbidity (McCarthy & Ashwell, 2006; Kahn Impereatore, & Cheng, 2005). This measure is becoming increasingly popular because of the association of cardio metabolic risk factors and visceral fat

(McCarthy & Ashwell, 2006; Kahn, Impereatore, & Cheng, 2005; Zhu, Wang, Heshka, Heo, Faith, & Heymsfield, 2002). Waist circumference was measured using a plastic flexible centimeter tape measure with the participant reclining in a supine position or while the participant is sitting in the wheelchair. Three measurements were recorded (to nearest 0.5cm) and the average calculated. Study participants were measured wearing minimal clothing to minimize measurement error. Measurements of the participant's horizontal torsal plane as well as at the natural waist (narrowest part of the torso) was performed. When the waist measurements proved difficult or impossible to obtain, a measure between the rib and the iliac crest was obtained following normal expiration (Tomey, Chen, Wang, & Braunschweig, 2005). The measurement of WC has the potential for determining obesity in individuals with SCI because of ease in application, ability to be monitored over time, and it requires no estimation of height (Rajan, McNeely, Warms, & Goldstein, 2008). The PI conducted all measurements during the home visit on day one of the study (estimated 5 minutes to complete).

Skin Assessment

After the administration of the above tests, the PI assisted the participant in transferring to bed if assistance was required. The participant's clothes and undergarments were removed. Hygiene was performed by the PI and/or trained researcher staff if the participant was soiled with urine and/or feces. The participant's skin was assessed in bed in a side lying position of the participant's dominant side. A penlight was used to inspect exposed and unexposed areas of the skin. The PI inspected the skin for color, edema, and lesions. Lesions were palpated and identified for shape, size, color, distribution, texture, surface relationship, exudates, tenderness, or pain. When palpating skin for temperature, the PI used the dorsal aspect of the dominant hand or fingers. When palpating skin turgor, the PI gently pulled up the skin and noted its return. The

PI assessed for edema by noting presence or absence and location, palpating for degree, and type of edema. All assessment data was recorded on the skin assessment form (Figure 4.8).

For any existing PUs, the lesion was staged according to the NPUAP/EPUAP guidelines (Table 1:1) (NPUAP/EPUAP 2014) and the PU was assessed using the Bates-Jensen Wound Assessment Tool (BWAT).

Bates-Jensen Wound Assessment Tool (BWAT)

The study utilized the Bates-Jensen Wound Assessment Tool (BWAT) formerly known as the Pressure Sore Status Tool (Bates-Jensen, Vredevoe, Brecht, 1992) to assess existing PUs. The BWAT contains 13 items that assess wound size, depth, edges, undermining, necrotic tissue type, and amount of exudate type and amount, surrounding skin color, edema, and induration, granulation, and epithelialization tissue. Each item is rated with a 5-point modified Likert scale with 1 indicating the healthiest for the characteristic and 5 indicating the unhealthiest attribute for each item (Bates-Jensen, Vredevoe, & Brecht, 1992). Once a PU has been assessed for each item on the BWAT, the 13 item scores can be summed to obtain a total score for the wound. Total scores range from 9 (wound closure) to 65 (profound tissue degeneration). The BWAT (Table 4:11) is used in many health care settings as a means of standardizing wound assessment and documentation of wound status among staff members.

The BWAT includes one page of instructions for use and there is also available a pictorial guide with images reflecting each of the individual BWAT items, which have also been developed and validated for use with the tool (Harris, Bates-Jensen, Parslow, Raizman, Singh, & Ketchen, 2010).

The original items on the BWAT were developed using a modified Delphi process, which involved use of a multi-disciplinary panel of experts in PU's and wound healing. Content

validity was established for each individual item on the tool and for the total tool (Bates-Jensen, Vredevoe, & Brecht, 1992). Reliability of the BWAT was demonstrated with wound care nurses among hospitalized adult patients with stage 2 through stage 4 trunk PUs and demonstrated high reliability with interrater and intrarater correlation coefficients all greater than 0.90 (Bates-Jensen, Vredevoe, & Brecht, 1992). Reliability with practitioners (licensed nurses and physical therapists) who did not have additional education or experience in wound assessment and management among nursing home residents with trunk and heel PU's resulted in lower reliability than the tool's use by specialists, but still within an acceptable range of inter-rater correlation coefficients all above 0.65 (Bates-Jensen & McNees, 1995; Bates-Jensen & McNees, 1996).

The PI is certified in wound care; therefore, all skin assessments and PU staging were performed by the PI for consistency and accuracy on day one of the study and it took about15 minutes to complete.

Protection of Human Subjects

An Institutional Review Board (IRB) protection of human subjects' application was submitted for approval to the University of California, Los Angeles (UCLA Office of Human Research Protection Program) prior to data collection. Recruitment tools identified to the IRB included recruitment flyers, and screening forms. Each consenting participant received information on the study at the time of signed consent including the potential risks and benefits of the study. Potential participants were told that they are volunteers in the study, and that services will not be withheld if they choose not to participate. They were also told that they do not have to answer any question that they do not want to answer, or they are not comfortable with answering.

Risks to the Subjects

a. Human Subjects Involvement and Characteristics:

The target population consists of 121 adult males and females, 21 years of age and older who are diagnosed with a SCI and able to communicate in English. This population was recruited via flyers and personal requests from five SCI care centers in the Los Angeles county area.

b. Inclusion of Children: Only those 21 years of age or older are eligible to participate in this study. Children are not included in this project because of the specific nature of the study, which targets adults with SCI with or without a PU

c. Women: No exclusions based on gender were made. Because we anticipate our sample to reflect the population of people in the SCI community, we anticipate the majority of our participants will be men (NSCISC, 2015).

d. Sources of Materials: There are five sources of data collection that were utilized: (1) demographic and medical information; (2) nutrition questionnaire (MNA®-SF, FFQ, and self-report 3-day food log; (3) disability status questioners (WHODAS 2.0, and SCI-SCG) (4) anthropometric measures (BMI, CAMA, TSF, and WC); and (5) physical measures (skin assessment).

f. Potential Risks and Benefits

1. Potential risks are possible embarrassment related to the skin assessments and anthropometric measurements. To help decrease this embarrassment, the PI ensured skin assessment and anthropometric measurements were performed in a private room, draping material was used appropriately, and personal areas were not subjected to undue exposure (Campbell and Lynn, 1990). Further embarrassment could be due to self-reporting food in the food log and social nutrition identification. To help decrease and or eliminate embarrassment

with the participant's food choices and food selection, the PI reassure participants throughout the reporting process that the goal of self-reporting food log is about gathering information not judgment.

The anticipated benefits of the study are increased knowledge, related to SCI, PUs, and nutritional status. No personal identifying information was released in any publications or reports, or to any other institutions. All results were reported in the aggregate so as not to identify an individual.

Adequacy of Protection against Risks

a. Recruitment and Informed Consent

The identification of individuals to include in the project and the coordination of the process will take place through flyers posted at centers. Patient identifiers (e.g., name, address, language) was not recorded and a code number was assigned. The faculty sponsor, PI and/or trained the research staff were the only ones who maintain this roster in a secure, locked file. All computer records/data was encrypted, and password protected. No information that might link an individual to any health condition or respondent responses were reported in any of the reports or given out.

b. Adequacy of Protection

All participants were required to give informed written approval for their participation in the project. The consent forms included a narrative describing the study. Consent consisted of a signed consent form (for individual or their proxy if the participant cannot sign) that detailed the data to be collected, how the data will be utilized, and an assurance of individual confidentiality.

c. Data confidentiality.

Confidentiality of data was maintained in this study through a number of procedures. When participants provide consent to participate, the PI assigned them a unique identification (ID) number. This ID number was used on all paper and electronic data including (1) demographic and medical information (2) nutrition questionnaire (MNA®-SF, FFQ, and self-report 3-day food log,), (3) disability status questioner (WHODAS 2.0 and SCI-SCS), (4) anthropometric measures (BMI, CAMA, Tricep Skin Folds, and WC), and (5) physical measures (skin assessment). A cover sheet was included that indicates the participants name and ID number to assist data collection for interacting with the participant. Once the packet was completed, the cover sheet was be removed and shredded so that the identity of residents cannot be determined from the data. The master file containing the names of participants and their unique identifiers was kept in a password protected computer file under the control of the faculty sponsor, Dr. Barbara Bates-Jensen who monitored and maintained confidentiality in collaboration with the PI.

d. Data Safety.

To maintain safety of data, only those research staff necessary were allowed access to computer and paper data files. All files were kept in a locked cabinet in Dr. Bates-Jensen's locked office and on password protected computers maintained on the UCLA School of Nursing's network and backed by university servers. The master file containing the names of participants and their unique identifiers were kept in a password protected computer file under the control of the faculty sponsor, Dr. Barbara Bates-Jensen who monitored and maintained confidentiality in collaboration with the PI.

Importance of Knowledge to be Gained

Information collected in this study has the potential to be used to inform and provide better nutritional care for individuals with SCI without and/or with a Primary Investigator living in the community.

Procedure

Following a recruitment process and screening to enroll study participants, the persons who agreed to be in the study were consented in writing prior to any data collection. Data collection took place Monday through Sunday during office hours (8:00AM-6:00PM).

The data collection is described and outlined below.

Day one:

- Consent forms were reviewed and signed.
- Collection of demographic and medical information forms filled out by participants.
- Introduction to nutritional forms, disability status forms, anthropometric procedures and skin assessment were performed.
- An example of a completed food log was given to the participants. Then, detailed instructions on how to complete the 3-day food log. Time was provided for questions and answers related to completing the food log. All information was hand written by the participants on the 3-day food log. Participants started their food log starting with their next meal.
- Anthropometric measures (WC and Tricep Skin Fold) were performed next. Waist circumference was measured using a plastic flexible centimeter tape measure with the participant reclining in a supine position or while the participant is sitting in the wheelchair. Tricep skinfold was measured by the participant's dominant arm raised at shoulder level with

the elbow bent and the triceps skinfold was measured at the midway point between the elbow and axilla using a large caliper. Next, following the triceps skinfold measurement, three mid arm circumference measurements were obtained with the dominant arm straight and at the participant's side, at the midway point between the elbow and shoulder using a flexible centimeter measuring tape.

- The PI assisted the participant in transferring to bed if assistance was required. The participant's clothes and undergarments were removed. Hygiene was performed by the PI if the participant was soiled with urine and/or feces. The participant's skin was assessed in bed in a side lying position of the participant's dominant side. The use of a penlight was utilized to inspect exposed and unexposed areas of the skin. Skin assessments of the participants to detect skin breakdown was performed by the PI to confirm evidence of a PU or no PU, its stage, duration, and size. The participant was assisted back to the wheelchair and hand hygiene was performed.
- Completion of nutrition questionnaires and disability status measurement forms in the following order: MNF-SF, FFQ, WHODAS 2.0, and SCI-SCS by PI.
- Follow up instructions by PI was given to participant verbally and in writing regarding follow-up telephone calls to remind participants to complete their food log and to schedule the date and time for the food log pick up.
- Contact information of the PI was provided to participants verbally and in writing.

Day two:

- Follow up phone calls were placed to participants to remind participants to complete the 3-day food log and to answer questions about completing the 3-day food log.

- If a participant was not reached by phone on day two, messages were left at a designated number provided by the participant and follow up calls were made on day three.

Day three:

- Follow up phone calls were placed to the participants for questions, and to remind the participants to complete their 3-day food log and to answer questions about completing the 3-day food log.
- Set a time to pick up 3-day food log on day 4.

Day four:

- The PI returned to the participant's home and clarify any and all unreadable/unrecognizable entries to the 3-day food log.
- 3-day food log was picked up.
- A $25.00 Target gift card was given to the participant

With the assistance from a trained Registered Dietitian and the use of a food processing program (ESHA), the 3-day food log was analyzed for dietary micronutrients, macronutrients and fluid intake, and totals for each were calculated for each meal and for each day using the average of the three days.

Chart 4:1. Study Process of Recruitment, Data Collection and Analysis Phases Timeline

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
PHASE I - Recruitment												
IRB Approval	X	X	X									
Flyers posted for recruitment			X	X	X	X	X	X	X	X		
Consent participants			X	X	X	X	X	X	X	X		
PHASE 2 – Data Collection												
Demographic and medical information				X	X	X	X	X	X	X		
Conduct interviews (In home interview, WHODAS 2.0, and SCI-SCS				X	X	X	X	X	X	X		
Nutritional questionnaire (MNA®-SF)				X	X	X	X	X	X	X		
Physical measure (BMI, waist circumference, skin assessment)				X	X	X	X	X	X	X		
PHASE 3 – Data Entry & Analysis												
Data entry											X	
Summary data on demographics											X	
Descriptive analysis on all measures										X	X	
Data management & preparation										X	X	
Data analysis												X
PHASE IV - Reports												
Dissertation report												X
Preparation of reports and publications												X

Data Analysis

The participants' social demographic characteristics were described using summary statistics of the frequency, distribution, mean, and measures of dispersion as appropriate.

Variables describing demographic and medical characteristics include age, ethnicity/race, gender, SCI characteristics, existing pressure ulcer stage and BWAT scores, and medical diagnoses. Descriptive statistics were calculated for the total study sample and for each of the two groups (with and without a PU) separately and presented as mean +/- standard deviation (SD), ranges for continuous variables such as age and BWAT scores and presented as frequency, and percentages for categorical variables such as ethnicity/race, gender, and medical diagnoses. The demographic variables were compared for the two groups (with and without a PU) using t-tests for continuous variables (such as age, BWAT scores) and chi square statistic or McNemar's test of proportions for categorical variables (such as ethnicity/race, gender). Data analyses for each specific aim and associated research question is presented below.

Aim 1: Describe nutritional intake of macronutrients and micronutrients among community dwelling non-ambulatory persons with a SCI with and without PU's.

Macronutrient intake included kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat (omegas 3 & 6), cholesterol, fiber and protein intake measured using a 3-day self-report food log. Micronutrient intake measures include vitamins A, B12, C, D, E, K, folate, and minerals calcium, iron, copper, and zinc measured using a 3-day self-report food log.

Prior to conducting data analyses, data from the self-report food log was prepared. This data was organized by macronutrients and micronutrients categories. Coding for each category proceeded from handwritten logs into the computer for data analysis. Each measure was given a score. For example, for macronutrient intake reporting, the calorie amount of each log entry was assessed, recorded, and summarized for each date. Each of the measures was assessed by the PI

and recorded into the computer for analysis. Micronutrient measures were likewise reported. To address Specific Aim #1, three research questions were examined:

Research Question 1A: Is there a relationship between macronutrient intake and micronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU?

For this question the variables to be correlated were the average 3-day summary macronutrient variables and the average 3-day summary micronutrient variables for the SCI individuals with a PU, then the same analyses were conducted in SCI individuals without a PU.

Pearson Product Moment correlation was used to examine the relationship between macronutrient intake & micronutrient intake among community dwelling non-ambulatory persons with a SCI with and without PU's. The variables used for this analysis were scores of the key macronutrient and the scores of the key micronutrients data. Score for micronutrients was the mean intake of each item Vitamin A, B12, C, D, E, K, and folate and minerals calcium, iron, copper, and zinc over three days according to the self-report food log. Score for macronutrients was the mean intake of each item (calorie, carbohydrates, saturated fat, and mono-saturated fat, polyunsaturated fat, cholesterol, fiber, and protein intake) over three days according to the self-report food log. The correlation matrix was conducted within each of the groups (with and without PU). The Pearson product-moment correlation coefficient is appropriate as it is a measure of the degree of linear dependence between two variables (Puth, Neuhauser, & Ruxton, 2014; Waltz, Strickland, & Lens, 2010).

Research Question 1B: Is there a difference in macronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU?

Student t-test was used to compare mean difference for each of the following macronutrient intake variables: (1) Calories; (2) daily ingested carbohydrates (such as cereals, bread, and

pasta); (3) daily ingested simple carbohydrates, (such as sugar found in candy, jams, and desserts); (4) daily ingested fats (combinations of saturated, monounsaturated, and polysaturated); (5) daily ingested fiber (complex carbohydrates such as whole grains, vegetables, and fruits); (6) daily ingested proteins (such as dry legumes, meat, fish, poultry) among community dwelling non-ambulatory persons with a SCI with and without PU's.

Research Question 1C: Is there a difference in micronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU?

Student t-test was used to compare the mean difference for each of the following micronutrient intake variables: (1) daily ingested minerals (such as calcium, iron, copper, and zinc); (2) daily ingested vitamins (such as Vitamin A, B12, C, D, E, K, and folate); (3) daily ingested essential fatty acids (such as omega-3 and omega-6) among community dwelling non-ambulatory persons with a SCI with and without PU's.

Aim 2: Describe and evaluate the relationship of psycho-social factors, anthropometric measurements, nutrition status measurement, and disability status measurement among community dwelling non-ambulatory person with a SCI with and without a PU

Psycho-social factors included: gender, race/ethnicity, level of SCI, duration of SCI, age, marital status, education, income, living arrangement, caregivers, grocery shopping, cooking, outside services used, medication, smoking (never, former, or current), and bowel & bladder function (incontinent, urinary retention, or indwelling catheter). Anthropometric measurements include: BMI, Tricep Skin Fold, and WC.). Nutrition status measurements include: Total score from the Mini Nutritional Assessment (MNA-SF; 2). Disability Status includes 1) summary score using simple summation of the World Health Organization Disability Assessment Schedule

2.0 (WHODAS 2.0) 36 questions; and 2) total score from the Spinal Cord Injury-Secondary Condition Scale (SCI-SCG).

To address Aim #2, four research questions were examined. Each of the measures were assessed by the PI and recorded into the computer for analysis.

Research Question 2A: What is the relationship between psychosocial factors, anthropometric measurements, nutrition status measurements, and disability status measurements among community dwelling non-ambulatory person with a SCI with and without a PU?

For this question the variables correlated were the total score nutrition status (MNA®-SF), psycho-social factors, and disability status variables with SCI person with a PU, then the same analyzes was conducted in SCI person without a PU.

Pearson Product Moment correlations were used to examine the correlation between psycho-social factors, nutrition status, & disability status among community dwelling non-ambulatory persons with a SCI with and without PU's**.** The variables that were used for this analysis were the total scores of the MNA®-SF, and psycho-social factors of (gender, race/ethnicity, level of SCI, duration of SCI, age, marital status, education, income, living arrangement, caregivers, grocery shopping, cooking, outside services used, medication, smoking (never, former, or current), bowel & bladder function (incontinent, urinary retention, or indwelling catheter), total score of WHODAS 2.0 and total score of SCI-SCS with a correlation matrices conducted within each group (with and without PU). This analysis used the Pearson product-moment correlation coefficient as a measure of the degree of linear dependence between two variables and was appropriate for these variables (Puth, Neuhauser, & Ruxton 2014; Waltz, Strickland, & Lens, 2010).

Research Question 2B: Is there a difference in psychosocial factors among community dwelling non-ambulatory person with a SCI with and without a PU?

Student t-tests (e.g. age, height, weight.) or Chi square analysis (e.g. gender race/ethnicity) was used to compare mean values and/or proportions among community dwelling non-ambulatory persons with a SCI with and without PU's.

Research Question 2C: Is there a difference in anthropometric measures among community dwelling non-ambulatory person with a SCI with and without a PU?

Student t-test was used to compare mean difference for each of the following anthropometric measurements: (1) BMI; (2) Tricep Skin Folds (3) WC; among community dwelling non-ambulatory persons with a SCI with and without PU's

Research Question 2D: Is there a difference in nutrition status measurement (Total MNA Score) among community dwelling non- ambulatory person with a SCI with and without a PU?

Student t-test was used to compare mean difference for each of the following nutrition status variables: total scores of the MNA®-SF among community dwelling non-ambulatory persons with a SCI with and without a PU's.

Aim 3: Describe and evaluate the relationship between macronutrients intake, micronutrients intake, anthropometric measurements, psycho-social factors, nutrition status measurement, and disability status measurements among community dwelling non-ambulatory person with a SCI with a Partial Thickness PU (Stage 2 PU) versus Full Thickness PU (Stage 3, 4, or Unstageable PU)

Macronutrient intake, micronutrient intake, anthropometric measurement, psycho-social factors, nutrition status measurements, and disability status measurement are the same as defined

in aim #1 and aim #2. Pressure ulcers stages 2, 3, 4, and unstageable are defined according to the 2014 NPUAP staging system (NPUAP 2014).

To address aim #3, three research questions were examined and only those SCI individuals with PU were included. We classify a PU according to the NPUAP/EPUAP guidelines (Table 1:1) (NPUAP/EPUAP, 2014). The participants were grouped with stage 2 PU compared to participants with stage 3, or 4 or unstageable PU.

Research question 3A: What is the relationship among macronutrient intake, micronutrient intake, among community dwelling non-ambulatory persons with an SCI with a partial thickness PU versus full thickness PU?

For this question the variables correlated were the summary score of the 3-day macronutrient intake, micronutrient intake, anthropometric measurement, psycho-social factors and nutrition status variables as defined in aims #1 and aim #2 for only those participants with any PU. One analysis was conducted for the participants with stage 2 PU and a second analysis for participants with stage 3, 4, or unstageable PU. This analysis used the Pearson product-moment correlation coefficient, which is a measure of the degree of linear dependence between two variables and is appropriate for this use. Pearson Product Moment correlation was performed to examine correlation between macronutrient intake, micronutrient intake, anthropometric measurement variables, psycho-social factors and nutrition status among community dwelling non-ambulatory persons with a SCI with a stage 2 PU versus stage 3, 4, or unstageable PU.

Research Question 3B: Is there a difference between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, and disability status measurements

among community dwelling non-ambulatory persons with an SCI with a partial thickness PU versus full thickness PU?

Student t-test was used to compare mean values for each of the following: (1) macronutrient intake variables; (2) micronutrient intake variables; (3) anthropometric measurements (4) psycho-social factors (5) disability status variables for the two groups (those community dwelling non-ambulatory persons with a SCI stage 2 PU versus those with stage 3, 4, or unstageable, PU).

Research Question 3C: Is there a difference in nutritional status (Total MNA Scores) among community dwelling non-ambulatory person with a SCI with a partial thickness PU versus full thickness PU?

Student t-test was used to compare mean values for each of the following: (1) nutritional status variables for the two groups (those community dwelling non-ambulatory persons with a SCI stage 2 PU versus those with stage 3, 4, or unstageable, PU).

SPSS statistical analysis version 25.0 was used (IBM Corp, 2012). Data was tested for normality using the Shapiro-Wilk's test. Correlations were conducted using Pearson Product Moment correlation. Student t-test was used to compare the mean value of the variables. A prior significance level is set at $P < 0.05$.

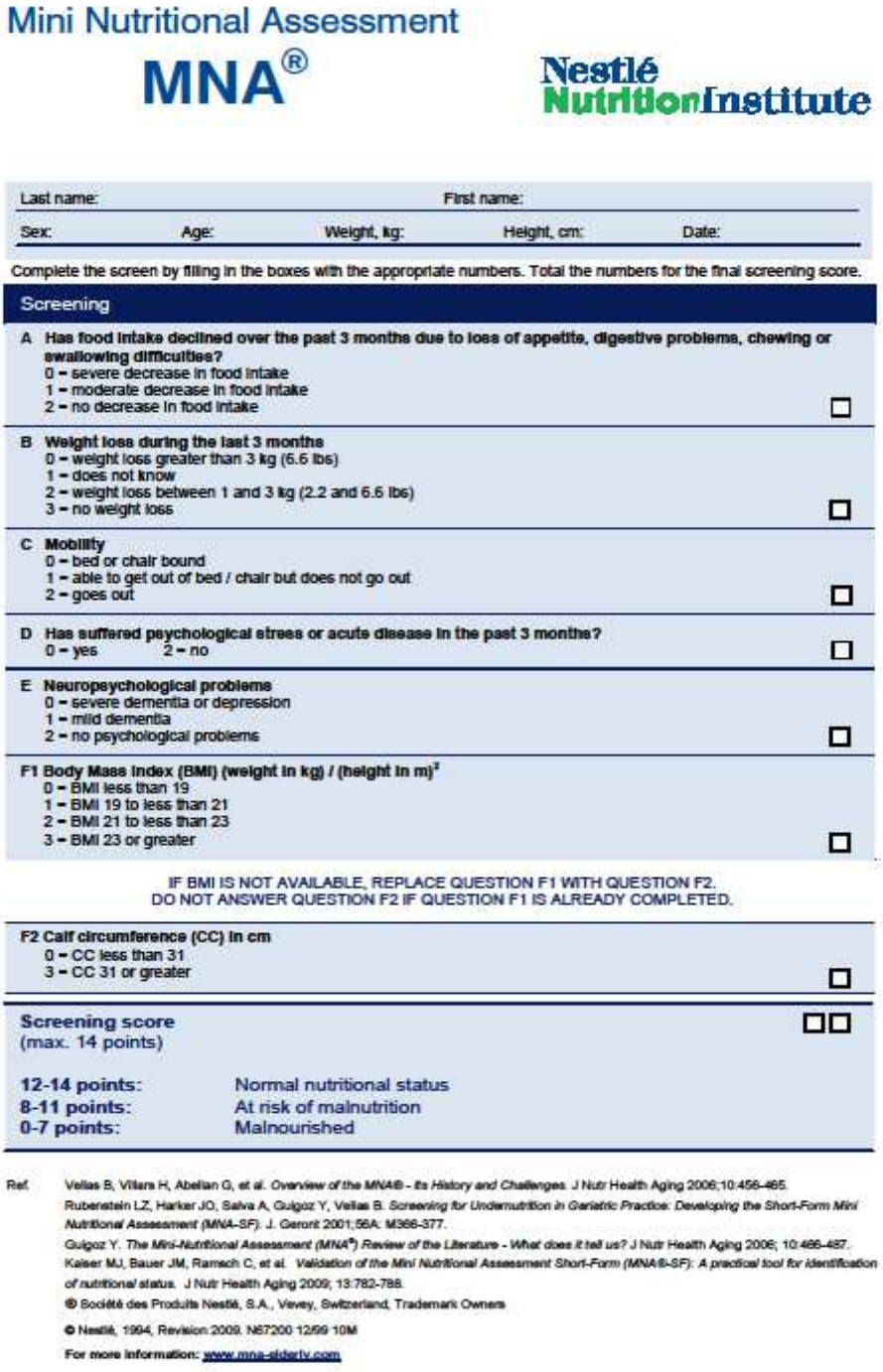
Summary

A study examining the nutritional status of community dwelling non-ambulatory person with a SCI with and without a PU is an important contribution to the literature and has the potential to greatly support non-ambulatory individuals who often present with several other medical conditions. Increasing survival rates for SCI individuals has been reported over several decades thought to be primarily due to an increase in medical care knowledge of targeted care for these

individuals and advancement in the tools and approaches to medical care treatment (National Institute of Neurological Disorders and Stroke ((NINDS), 2015). A closer examination of poor nutrition and limited physical activity and its association to medical outcomes among this population has the potential to reduce the higher risk of secondary medical conditions, which limits healing (Khalil, Gorgey, Janisko, Dolbow, Moore, & Gater, 2013).

This study goes further to examine the impact of nutrition on SCI individuals with and without PUs, which again can support SCI individuals as well as inform nursing practice, and medical care providers. Exploration of the association between several factors utilizing, anthropometric variables, dietary intake logs, and psychosocial nutritional factors provides a rich dataset that can be utilized to train medical care workers, inform families, and SCI individuals with a PU of the relationship of nutrition and poor health outcomes. Chronic diseases coupled with poor nutrition, can result in a greater risk for the development of PUs, which are often hard to control. In addition, lack of attention and assistance in physical activity may be improved through better knowledge of the risks associated with poor nutrition. This may lower healthcare costs and improve resources for SCI and families. This research is important for practice because nurses and providers process and review the medical records and discharge plans and are in a position to respond to the needs of SCI individuals with or without PUs.

Table 4:1 Mini Nutrition Assessment



Mini Nutritional Assessment

MNA®

Nestlé Nutrition Institute

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A **Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?**
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake ☐

B **Weight loss during the last 3 months**
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C **Mobility**
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out ☐

D **Has suffered psychological stress or acute disease in the past 3 months?**
0 = yes 2 = no ☐

E **Neuropsychological problems**
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F1 **Body Mass Index (BMI) (weight in kg) / (height in m)²**
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2.
DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 **Calf circumference (CC) in cm**
0 = CC less than 31
3 = CC 31 or greater ☐

Screening score ☐☐
(max. 14 points)

12-14 points: Normal nutritional status
8-11 points: At risk of malnutrition
0-7 points: Malnourished

Ref. Vellas B, Villars H, Abellan G, et al. *Overview of the MNA® - Its History and Challenges.* J Nutr Health Aging 2006;10:456-465.
Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. *Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF).* J. Geront 2001;56A: M366-377.
Guigoz Y. *The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us?* J Nutr Health Aging 2006; 10:466-487.
Kaiser MJ, Bauer JM, Ramsch C, et al. *Validation of the Mini Nutritional Assessment Short-Form (MNA®-SF): A practical tool for identification of nutritional status.* J Nutr Health Aging 2009; 13:782-788.

For more information: www.mna-elderly.com

Table 4:2 Block Food Frequency Questionnaire (FFQ)

FOOD AND ACTIVITY QUESTIONNAIRE

RESPONDENT ID #

TODAY'S DATE

	DAY	YEAR
Jan		
Feb		
Mar	0 0	2014
Apr	1 1	2015
May	2 2	2016
Jun	3 3	2017
Jul	4	2018
Aug	5	2019
Sep	6	2020
Oct	7	2021
Nov	8	2022
Dec	9	2023

ABOUT THIS SURVEY

Please answer each question as best you can. Estimate if you aren't sure.

- **DETACH THE LAST PAGE OF THIS BOOKLET.** These are your portion pictures.
- **USE ONLY A NUMBER 2 PENCIL.**
- **FILL IN THE CIRCLES COMPLETELY** and erase completely if you make any changes.

ABOUT YOU

SEX
- Male
- Female

If female, are you pregnant or breast feeding?
- No
- Yes
- Not female

AGE

WEIGHT pounds

HEIGHT feet inches

INSTRUCTIONS

This form is about the foods you usually eat. Think about your usual intake over the last year. This includes all meals or snacks, at home, in a restaurant, or carry-out.

Please tell us...

1. **HOW OFTEN,** on average, did you eat the food?
   DO NOT SKIP any foods. Mark "Never" if you didn't eat any of the food.
2. **HOW MUCH** of the food did you usually eat on the days you ate it?
   Sometimes we ask "how much" as A, B, C or D. **LOOK AT THE PORTION PICTURES.**
   Pick the picture that looks the most like the serving size you usually eat.
   (If you don't have pictures: A=1/4 cup, B=1/2 cup, C=1 cup, D=2 cups.)
3. **WHAT TYPE?** For some foods we ask the type (low-fat, low-sugar...) near the end of the survey.

EXAMPLE: This person drank orange juice twice a week, and had one glass each time.
Once a week this person ate a "C"-sized serving of cold cereal (about 1 cup).

	HOW OFTEN in the past year? NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Orange juice						●				How many glasses 1 ● 2 ○ 3 ○ 4 ○
Cold cereal					●					Which bowl A ○ B ○ C ● D ○

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

EGGS and DAIRY FOODS	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Breakfast sandwiches or breakfast burritos with eggs or meat	○	○	○	○	○	○	○	○	○	How many sandwiches in a day: 1 2
Other eggs like scrambled or boiled, or quiche (not egg substitutes)	○	○	○	○	○	○	○	○	○	How many eggs a day: 1 2 3 4
Yogurt (not frozen yogurt)	○	○	○	○	○	○	○	○	○	Which bowl: B C D
Cottage cheese, ricotta cheese	○	○	○	○	○	○	○	○	○	How much: A B C D
Cream cheese, sour cream, dips	○	○	○	○	○	○	○	○	○	How many tablespoons: 1 2 3 4
Cheese, sliced cheese, cheese spread, including in sandwiches and quesadillas	○	○	○	○	○	○	○	○	○	How many slices: 1 2 3 4
CEREALS, GRAINS, BREADS										
Cold cereals, ANY KIND, like corn flakes, fiber cereals, sweetened cereals	○	○	○	○	○	○	○	○	○	Which bowl: B C D
Oatmeal, or whole grain cereal like Wheatena or Ralston	○	○	○	○	○	○	○	○	○	Which bowl: A B C D
Grits, cream of wheat, cornmeal mush	○	○	○	○	○	○	○	○	○	Which bowl: A B C D
Milk or milk substitutes on cereal	○	○	○	○	○	○	○	○	○	
Brown rice, or dishes made with brown rice	○	○	○	○	○	○	○	○	○	How much in a day: B C D
White rice, or dishes made with white rice, like rice and beans	○	○	○	○	○	○	○	○	○	How much in a day: B C D
Pancakes, waffles, French toast, crepes	○	○	○	○	○	○	○	○	○	How many: 1 2 3 4
Breakfast pastries, like muffins, scones, sweet rolls, Danish, Pop Tarts, pan dulce	○	○	○	○	○	○	○	○	○	How many pieces: 1 sm 1 med 2 3
Biscuits, not counting breakfast sandwiches	○	○	○	○	○	○	○	○	○	How many: 1 sm 1 med 2 3
Corn bread, corn muffins, hush puppies	○	○	○	○	○	○	○	○	○	How many pieces in a day: 1/2 1 2 3
Hamburger buns, hotdog buns, submarine or hoagie buns	○	○	○	○	○	○	○	○	○	How many buns in a day: 1/2 1 2 3
Bagels or English muffins, dinner rolls, pita, naan	○	○	○	○	○	○	○	○	○	How many: 1/2 1 2 3
Tortillas (not counting in tacos or burritos)	○	○	○	○	○	○	○	○	○	How many in a day: 1 2 3 4
Any other bread or toast, including white, dark, whole wheat, and what you have in sandwiches	○	○	○	○	○	○	○	○	○	How many slices in a day: 1 2 3 4
VEGETABLES										
Broccoli, Chinese broccoli, or Brussels sprouts	○	○	○	○	○	○	○	○	○	How much: A B C D
Carrots and mixed vegetables containing carrots	○	○	○	○	○	○	○	○	○	How much: A B C D
Corn	○	○	○	○	○	○	○	○	○	How much: A B C D
Green beans, string beans, green peas	○	○	○	○	○	○	○	○	○	How much: A B C D
Cooked greens like spinach, collards, turnip greens, kale, mustard greens	○	○	○	○	○	○	○	○	○	How much: A B C D

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Cabbage, cole slaw, Chinese cabbage	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Green salad with lettuce or raw spinach	○	○	○	○	○	○	○	○	○	How much ○ 1/2 cup ○ 1 cup ○ 2 cups ○ 3+ cups
Raw tomatoes	○	○	○	○	○	○	○	○	○	How much ○ 1/4 ○ 1/2 ○ 1 ○ 2
Salad dressing	○	○	○	○	○	○	○	○	○	How many tablespoons ○ 1 ○ 2 ○ 3 ○ 4
Avocado, guacamole	○	○	○	○	○	○	○	○	○	How many tablespoons ○ 1 ○ 2 ○ 3 ○ 4
Sweet potatoes, yams	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
French fries, home fries, hash browns, tater tots	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Potatoes not fried, like baked, boiled, mashed, or in stew or potato salad	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Any other vegetable, like squash, cauliflower, peppers, okra, nopales	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
FRUITS										
How often do you eat the following 2 items, just during the summer months when they are in season?										
Watermelon, cantaloupe, honeydew, other melons, in season	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Strawberries or other berries, in season	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
How often do you eat the following fruits all year round? Estimate your average for the whole year. Include fresh or frozen fruits. Only include canned or dried fruit when mentioned.										
Bananas	○	○	○	○	○	○	○	○	○	How many in a day ○ 1/2 ○ 1 ○ 2
Apples or pears	○	○	○	○	○	○	○	○	○	How many in a day ○ 1/2 ○ 1 ○ 2
Oranges, tangerines, grapefruit	○	○	○	○	○	○	○	○	○	How many ○ 1/2 ○ 1 ○ 2
Peaches and nectarines	○	○	○	○	○	○	○	○	○	How many ○ 1/2 ○ 1 ○ 2
Any other fresh fruit, like grapes, plums, mango, fruit salad	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Raisins, dates, other dried fruit	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C
Canned fruit, like applesauce, fruit cocktail, canned peaches or pineapple	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
BEANS, TOFU, and MEAT SUBSTITUTES **Include those eaten alone, or in mixed dishes like burritos, chili, stir-fry, salad**										
Refried beans, bean burritos, or hummus	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Pinto beans, black beans, kidney beans, baked beans, lentils	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Tofu or tempeh	○	○	○	○	○	○	○	○	○	How much ○ A ○ B ○ C ○ D
Meat substitutes, like veggie burgers, veggie chicken, vegetarian hot dogs or vegetarian lunch meats	○	○	○	○	○	○	○	○	○	How much ○ A ○ B 1 patty or dog ○ C ○ D

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SERIAL #

SOUPS, MIXED DISHES, and NOODLES	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Split pea, bean, or lentil soup	○	○	○	○	○	○	○	○	○	Which **bowl** ○ B ○ C ○ D
Vegetable soup, vegetable beef soup, or tomato soup	○	○	○	○	○	○	○	○	○	Which **bowl** ○ B ○ C ○ D
Any other soup, including chicken noodle, cream soups, Cup-A-Soup, ramen	○	○	○	○	○	○	○	○	○	Which **bowl** ○ B ○ C ○ D
Pizza or pizza pockets	○	○	○	○	○	○	○	○	○	How many **slices** ○ 1 ○ 2 ○ 3 ○ 4
Macaroni and cheese	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Spaghetti, lasagna, other pasta with tomato sauce	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Other noodles like plain pasta, pasta salad, sopa seca	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Egg rolls, won tons, samosas, empanadas	○	○	○	○	○	○	○	○	○	How many **pieces** ○ 1 ○ 2 ○ 3 ○ 4
MEAT and CHICKEN										
Hamburgers, cheeseburgers, turkey burger, at home or from a restaurant	○	○	○	○	○	○	○	○	○	How **many** ○ 1 sm ○ 1 lrg ○ 2 ○ 3
Hot dogs or dinner sausage like Polish, Italian, chicken apple	○	○	○	○	○	○	○	○	○	How **many** ○ 1 ○ 2 ○ 3 ○ 4
Bacon or breakfast sausage	○	○	○	○	○	○	○	○	○	How many **pieces** ○ 1 ○ 2 ○ 3 ○ 4
Lunch meats like bologna, sliced ham, sliced turkey, salami	○	○	○	○	○	○	○	○	○	How many **slices** ○ 1 ○ 2 ○ 3 ○ 4
Meat loaf, meat balls	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Steak, roast beef, pot roast, including in frozen dinners or sandwiches	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Tacos, burritos, enchiladas, tamales, tostadas, with meat or chicken	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Ribs, spareribs	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Pork chops, pork roast, cooked ham (including for breakfast)	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Any other beef or pork dish like stew, pot pie, corned beef hash, chili, Hamburger Helper, curry	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Liver, including chicken livers or liverwurst	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C
Pigs feet, neck bones, oxtails, tongue, chitlins	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C
Veal, lamb, goat, deer meat, other game	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C
Fried chicken, including chicken fingers, chicken nuggets, wings, chicken patty	○	○	○	○	○	○	○	○	○	How many **medium pieces** ○ 1 ○ 2 pcs/ 6 nuggets ○ 3 ○ 4
Roasted or broiled chicken or turkey	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B medium piece ○ C ○ D half chicken
Any other chicken or turkey dish, like chicken stew or curry, chicken salad, stir-fry, Chinese chicken dishes	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D

FISH, SEAFOOD	NEVER	A FEW TIMES per YEaR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Oysters	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C
Shellfish like shrimp, scallops, crab	○	○	○	○	○	○	○	○	○	How much **fish** ○ A ○ B ○ C ○ D
Tuna, tuna salad, tuna casserole	○	○	○	○	○	○	○	○	○	How much **of the tuna** ○ A ○ B ○ C
Salmon, mackerel, sea bass, trout, sardines, herring, without breading	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Fried fish, fish sticks, fish sandwich, breaded fillets	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Any other fish	○	○	○	○	○	○	○	○	○	How much **fish** ○ A ○ B ○ C ○ D
NUTS, SEEDS, SNACKS										
Peanut butter or other nut butters	○	○	○	○	○	○	○	○	○	How many **tablespoons** ○ 1/2 ○ 1 ○ 2 ○ 3
Walnuts or flax seeds (don't count flaxseed oil)	○	○	○	○	○	○	○	○	○	How **much** ○ 1 Tbsp ○ 2 Tbsp ○ 1/4 cup ○ 1/2 cup
Peanuts, sunflower seeds, other nuts or seeds	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Energy or protein bars, like Power Bar, Clif, Balance, Luna, South Beach, Atkins	○	○	○	○	○	○	○	○	○	How **much** ○ Small ○ Medium ○ Large
Breakfast bars, cereal bars, granola bars (not energy or protein bars)	○	○	○	○	○	○	○	○	○	How **many** ○ 1 ○ 2 ○ 3
Popcorn	○	○	○	○	○	○	○	○	○	How many **cups** ○ 1-2 ○ 3-6 ○ 7-9 ○ 10-12
Whole grain crackers, like Wheat Thins, RyeKrisp, Ryvita, Wasa	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Any other crackers, like saltines, Ritz, Cheez-Its, cheese-filled pretzels	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Tortilla chips or corn chips, like Fritos, Doritos, corn nuts	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
Any other snack chips, like potato chips, Cheetos, Chex mix	○	○	○	○	○	○	○	○	○	How **much** ○ A ○ B ○ C ○ D
SWEETS AND DESSERTS										
Donuts	○	○	○	○	○	○	○	○	○	How **many** ○ 1 mini ○ 1 med ○ 2 ○ 3
Cake or snack cakes like cupcakes, Twinkies, pound cake, banana bread	○	○	○	○	○	○	○	○	○	How many **pieces** ○ 1 sm ○ 1 med ○ 2 ○ 3
Cookies, brownies	○	○	○	○	○	○	○	○	○	How **many** ○ 1-2 ○ 3-4 ○ 5-6 ○ 7+
Pumpkin pie, sweet potato pie	○	○	○	○	○	○	○	○	○	How many **pieces** ○ 1/2 ○ 1 ○ 2 ○ 3
Any other pie or cobbler, including fast food pies, snack pies	○	○	○	○	○	○	○	○	○	How many **pieces** ○ 1/2 ○ 1 ○ 2 ○ 3
Ice cream, ice cream bars, frozen yogurt, fast food milkshakes	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Pudding, custard, rice pudding, flan	○	○	○	○	○	○	○	○	○	How **much** ○ B ○ C ○ D
Chocolate or other flavored sauces or syrup, on ice cream	○	○	○	○	○	○	○	○	○	How **much** ○ 1-2 Tbspn ○ 3-4 Tbspn ○ 1/2 cup

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SERIAL #

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D				
Popsicles, jello, frozen fruit bars, slushies, sherbet (don't count sugar-free)	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Chocolate candy, candy bars like Snickers, Hershey's, M&Ms	○	○	○	○	○	○	○	○	○	How much in a day	○ 1 mini	○ 1 med	○ 1 lrg	○ 1 king
Any other candy, not chocolate, like hard candy, Lifesavers, Skittles, Starburst, breath mints, chewing gum (NOT sugar free)	○	○	○	○	○	○	○	○	○	How much in a day	○ 1-2 pcs	○ 1/2 pkg	○ 1 pkg	○ 2 pkgs
SPREADS, SAUCES, OTHER FOODS														
Margarine (not butter) on bread, rice, vegetables, or other foods	○	○	○	○	○	○	○	○	○	How many pats (tsps)	○ 1	○ 2	○ 3	○ 4
Butter (not margarine) on bread, rice, vegetables, or other foods	○	○	○	○	○	○	○	○	○	How many pats (tsps)	○ 1	○ 2	○ 3	○ 4
Mayonnaise, sandwich spreads	○	○	○	○	○	○	○	○	○	How many tablespoons	○ 1/2	○ 1	○ 2	○ 3
Ketchup, salsa, chili sauce, chili peppers	○	○	○	○	○	○	○	○	○	How many tablespoons	○ 1/2	○ 1	○ 2	○ 3
Mustard, barbecue sauce, soy sauce	○	○	○	○	○	○	○	○	○	How many tablespoons	○ 1/2	○ 1	○ 2	○ 3
Gravy, or other rich sauces like Alfredo, white sauce, mole, peanut sauce	○	○	○	○	○	○	○	○	○	How many cups	○ 1/4	○ 1/2	○ 1	
Jam, jelly, marmalade	○	○	○	○	○	○	○	○	○	How many tablespoons	○ 1/2	○ 1	○ 2	○ 3
Pickles, pickled vegetables, sauerkraut, kimchi	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Salt, added to your food at the table	○	○	○	○	○	○	○	○	○	How many shakes in a day	○ 1-3	○ 4-5	○ 6-7	○ 8+
BEVERAGES														
Chocolate milk, cocoa, hot chocolate	○	○	○	○	○	○	○	○	○	How many 12 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Glasses of milk or soy milk, (not counting on cereal, in coffee, or chocolate milk)	○	○	○	○	○	○	○	○	○	How many 8 ounce servings	○ 1	○ 2	○ 3	○ 4
Meal replacement drinks like Slim Fast, Ensure, or high protein drinks or powders	○	○	○	○	○	○	○	○	○	How many cans or glasses	○ 1	○ 2	○ 3	○ 4
Tomato juice, V-8, other vegetable juice	○	○	○	○	○	○	○	○	○	How many 8 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Real 100% orange juice or grapefruit juice. Don't count orange soda or Sunny Delight.	○	○	○	○	○	○	○	○	○	How many 8 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Other 100% juices, like apple, grape, 100% fruit blends, or fruit smoothies	○	○	○	○	○	○	○	○	○	How many 8 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Hi-C, cranberry juice cocktail, Hawaiian Punch, Tang	○	○	○	○	○	○	○	○	○	How many 12 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Drinks with some juice like Sunny Delight, Knudsen	○	○	○	○	○	○	○	○	○	How many 12 ounce servings	○ 1/2	○ 1	○ 2	○ 3
Iced tea, homemade, instant or bottled, like Nestea, Lipton, Snapple, Tazo	○	○	○	○	○	○	○	○	○	How many 16-oz. glasses or bottles	○ 1/2	○ 1	○ 2	○ 3
Gatorade, Powerade, or other sports drinks	○	○	○	○	○	○	○	○	○	How much in a day	○ 1 16-ounce bottle ○ 1 20-ounce bottle ○ 2 16-ounce bottles ○ 2 20-ounce bottles			

	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH on those days? SEE PORTION SIZE PICTURES FOR A-B-C-D
Energy drinks like Red Bull, Rockstar, Monster	○	○	○	○	○	○	○	○	○	How much in a day: ○ 1 8-ounce can ○ 1 12-16 ounce can ○ 1 20-ounce can ○ 24 ounces or more
Kool-Aid, lemonade, fruit flavored drinks, like Crystal Light, atole, horchata (not iced tea)	○	○	○	○	○	○	○	○	○	How much in a day: ○ 1 8-ounce glass ○ 1 12-16-ounce glass or bottle ○ 1 20-ounce bottle ○ 30 ounces or more
Soft drinks, soda, pop, like cola, 7-Up, orange soda, regular or diet	○	○	○	○	○	○	○	○	○	How many in a day: ○ 1 can ○ 1 20-ounce bottle ○ 2 cans ○ Big Gulp or 3 cans
Beer or non-alcoholic beer	○	○	○	○	○	○	○	○	○	How much in a day: ○ 1 can ○ 2 cans ○ 3-4 cans or small pitcher ○ 5+ cans or large pitcher
Wine or wine coolers	○	○	○	○	○	○	○	○	○	How many glasses in a day: ○ 1/2 glass ○ 1 glass ○ 2 glasses, 1/2 bottle ○ 4+ glasses
Liquor or mixed drinks, cocktails	○	○	○	○	○	○	○	○	○	How many drinks: ○ 1 ○ 2 ○ 3 ○ 4
Water, bottled or tap	○	○	○	○	○	○	○	○	○	How many glasses: ○ 1 ○ 2 ○ 3-4 ○ 5+
Milky coffee drinks like latte, mocha, cappuccino, Frappuccino	○	○	○	○	○	○	○	○	○	How much in a day: ○ 12 oz ○ 16 oz ○ 20 oz ○ 24+ oz
Coffee (brewed or instant), regular or decaf	○	○	○	○	○	○	○	○	○	How many in a day: ○ 1 ○ 2 ○ 3 ○ 4+
Hot tea (not including herbal tea)	○	○	○	○	○	○	○	○	○	How many cups in a day: ○ 1 ○ 2 ○ 3 ○ 4+

MILKY COFFEE DRINKS: What kind do you usually drink? **MARK ONLY ONE**

○ Frappuccino ○ Mocha ○ Latte or cappuccino ○ Café con leche ○ Some of each ○ Don't drink them

What are your milky coffee drinks usually made with? **MARK ONLY ONE**

○ Whole milk ○ Skim milk or non-fat ○ Something else
○ 1 or 2% milk (reduced fat) ○ Soy milk ○ Don't drink

COFFEE: Is your coffee usually regular or decaf? ○ Decaf ○ Regular ○ Both kinds ○ Don't drink coffee

What do you usually add to your regular or decaf coffee? **MARK ONLY ONE**

○ Cream or half-n-half ○ Condensed milk ○ None of these
○ CoffeeMate, non-dairy creamer ○ Any other milk

Do you usually add sugar (or honey) to coffee? ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

HOT TEA: Is your hot tea usually regular or decaf? ○ Decaf ○ Regular ○ I drink both kinds ○ Don't drink tea

What do you usually add to your hot tea? **MARK ONLY ONE**

○ Cream or half-n-half ○ Condensed milk ○ None of these
○ CoffeeMate, non-dairy creamer ○ Any other milk

Do you usually add sugar (or honey) to hot tea? ○ No ○ Yes IF YES, how many teaspoons each cup? ○ 1 ○ 2 ○ 3 ○ 4

If you eat the following foods, what type do you usually eat? MARK ONLY ONE ANSWER FOR EACH QUESTION

Milk	○ Whole milk	○ 2% milk	○ 1% milk (low-fat)	○ Skim milk, non-fat	
	○ Soy milk	○ Rice milk	○ Almond milk, other	○ Don't drink	
Slimfast, Ensure, or high protein drinks	○ Slimfast, Ensure, regular	○ Slimfast, Ensure, light or low-carb			
	○ High protein drinks, regular	○ High protein drinks, light or low-carb	○ Don't know/Don't drink		
Real 100% orange or grapefruit juice	○ Calcium-fortified	○ Not calcium-fortified	○ Don't know	○ Don't drink	
Iced tea	○ Home-made, no sugar	○ Bottled, no-sugar	○ Don't drink		
	○ Home-made, with sugar	○ Bottled, pre-sweetened			
Drinks like Kool-Aid, lemonade, Crystal Light	○ Low-calorie, sugar-free	○ Regular	○ Don't drink		
Energy drinks like Red Bull, Monster	○ Sugar-free	○ Regular	○ Don't drink		
Soft drinks, soda, pop	○ Diet, low-calorie	○ Regular	○ Don't drink		
Do they usually have caffeine?	○ Has caffeine	○ No caffeine	○ Don't drink		
Beer	○ Regular	○ Light	○ Non-alcoholic	○ Don't drink	
Wine or wine cooler	○ Red wine	○ White wine	○ Both red and white wine	○ Don't drink	
Cheese	○ Low-fat	○ Regular-fat	○ Don't eat		
Yogurt	○ Plain (no sugar or fruit)	○ With fruit or other flavors			
Yogurt	○ Low-fat	○ Non-fat	○ Regular (whole milk)	○ Don't eat	
Salad dressing	○ Low-fat, lite	○ Fat free	○ Regular	○ Oil & vinegar	○ Don't use
Spaghetti or lasagna	○ Meatless	○ With meat sauce or meatballs	○ Don't eat		
Noodles, pasta	○ Rarely whole grain	○ Sometimes whole grain	○ Usually whole grain	○ Don't know/don't eat	
Burgers	○ Hamburger	○ Cheeseburger	○ Turkey burger	○ Don't eat	
Beef or pork	○ Avoid eating the fat	○ Sometimes eat the fat	○ Often eat the fat	○ Don't eat	
Chicken or turkey	○ Avoid eating the skin	○ Sometimes eat the skin	○ Often eat the skin	○ Don't eat	
Hot dogs, dinner sausage	○ Beef or pork	○ Chicken or turkey, low-fat	○ Don't eat		
Lunch meats	○ Beef or pork	○ Chicken or turkey, low-fat	○ Don't eat		
Cakes, snack cakes, cupcakes	○ Low-sugar, low-carb	○ Low-fat	○ Regular-fat	○ Don't eat	
Cookies, brownies	○ Low-sugar, low-carb	○ Low-fat	○ Regular-fat	○ Don't eat	
Ice cream, frozen yogurt	○ Low-sugar, low-carb	○ Low-fat or frozen yogurt	○ Regular	○ Don't eat	
Energy or protein bars	○ High energy	○ High protein	○ Some of each	○ Don't know	○ Don't eat
Bagels, English muffins, rolls	○ White	○ Multi-grain	○ 100% whole wheat	○ Eat all kinds	○ Don't eat
Burger, hot dog, submarine buns	○ White	○ Multi-grain	○ 100% whole wheat	○ Eat all kinds	○ Don't eat
Bread	○ White (<u>not</u> whole grain)	○ 100% whole wheat	○ Don't eat		
	○ Multi-grain, rye, or other brown bread	○ Eat some of each			
Tortillas	○ Corn tortillas	○ Flour tortillas (wheat)	○ Eat all kinds or don't know	○ Don't eat	
Popcorn	○ Air popped, fat-free	○ Low-fat or light	○ Regular	○ Caramel corn	○ Don't know	○ Don't eat
Crackers, pretzels	○ Low-fat, including RyeKrisp, rice cakes, or plain pretzels	○ Don't know			
	○ Regular-fat crackers or filled pretzels	○ Don't eat			
Mayonnaise or sandwich spreads	○ Low-fat, light	○ Regular	○ Don't eat		

If you eat **cold cereals,** what do you usually eat? Choose **ONE or TWO** that you eat most often. If you usually eat just one kind, only choose one.

○ All-Bran Original	○ Cinnamon Toast Crunch	○ Grape Nuts	○ Special K, plain
○ All-Bran Complete, Complete	○ Cocoa Krispies, Pebbles, Puffs	○ Honey Bunches of Oats	○ Special K, flavors
○ Apple Jacks, Cookie Crisp	○ Corn Flakes, Corn Puffs	○ Kashi GOLEAN, Heart to Heart	○ Total
○ Bran Flakes	○ Corn Pops	○ Life	○ Wheaties
○ Cap'n Crunch	○ Fiber-One, Bran Buds	○ Lucky Charms, Fruity Pebbles	○ *Other sweet cereal*
○ Cheerios, plain or Multi-Grain	○ Froot Loops	○ Oatmeal Squares, Oat Bran	○ *Other unsweetened cereal*
○ Cheerios, Honey Nut, flavors	○ Frosted Flakes	○ Raisin Bran	○ *Other whole grain cereal*
○ Chex, Wheat	○ Frosted Mini-Wheats	○ Rice Krispies, puffed rice	○ *Other bran or fiber cereal*
○ Chex, other	○ Granola	○ Shredded Wheat	○ *Don't eat cereal*

Which **fats or oils** are used most often for **cooking or frying** (<u>not</u> baking) in your home? **MARK ONLY ONE OR TWO**

○ Non-stick spray or none	○ Soft tub margarine	○ Corn oil, vegetable oil and blends	○ Other oil
○ Butter or ghee	○ Low-fat margarine	○ Peanut oil	○ Don't know
○ Butter/margarine blend	○ Olive oil	○ Lard, fatback, or bacon fat	
○ Stick margarine	○ Canola oil, safflower oil	○ Vegetable shortening, Crisco	

PLEASE DO NOT WRITE IN THIS AREA

○○○○○○○○○○○○○○○○○○○○○○○○

SERIAL #

What vitamin supplements do you take fairly regularly?

Multiple Vitamins. Do you take...	HOW OFTEN: DIDN'T TAKE	A FEW DAYS per MONTH	1 DAY per WEEK	2 DAYS per WEEK	3-4 DAYS per WEEK	5-6 DAYS per WEEK	EVERY DAY	FOR HOW MANY YEARS?: LESS THAN 1 YEAR	1-4 YEARS	5-9 YEARS	10+ YEARS
Prenatal vitamins	○	○	○	○	○	○	○	○	○	○	○
Regular One-A-Day, Centrum, "senior" vitamins or house brands of multiple vitamins	○	○	○	○	○	○	○	○	○	○	○
Stress-tabs or B-Complex type	○	○	○	○	○	○	○	○	○	○	○
Antioxidant combination, eye formula	○	○	○	○	○	○	○	○	○	○	○
Single Vitamins or Minerals, taken alone or in combination. Do not count what is in your multiple vitamins above.											
Vitamin A (not beta-carotene)	○	○	○	○	○	○	○	○	○	○	○
Vitamin B-6	○	○	○	○	○	○	○	○	○	○	○
Vitamin B-12	○	○	○	○	○	○	○	○	○	○	○
Vitamin C	○	○	○	○	○	○	○	○	○	○	○
Vitamin D	○	○	○	○	○	○	○	○	○	○	○
Vitamin E	○	○	○	○	○	○	○	○	○	○	○
Folic acid, folate	○	○	○	○	○	○	○	○	○	○	○
Calcium or antacids with calcium, like Tums	○	○	○	○	○	○	○	○	○	○	○
Iron	○	○	○	○	○	○	○	○	○	○	○
Zinc	○	○	○	○	○	○	○	○	○	○	○
Cod liver oil, other fish oils, omega-3, flax seed oil, algae	○	○	○	○	○	○	○	○	○	○	○
Fiber supplements like Benefiber, Metamucil	○	○	○	○	○	○	○	○	○	○	○

If you take One-A-Day, Centrum or other types of multiple vitamins, do you usually take types that
○ Contain minerals, iron, zinc, etc. ○ Do not contain minerals ○ Don't know

If you take vitamin C, how many milligrams of **vitamin C** do you usually take, on the days you take it? (Select the closest amount)
○ 100 ○ 250 ○ 500 ○ 750 ○ 1000 ○ 1500 ○ 2000 ○ 3000+ ○ Don't know

If you take vitamin E, how many IUs of **vitamin E** do you usually take, on the days you take it? (Select the closest amount)
○ 100 ○ 200 ○ 300 ○ 400 ○ 600 ○ 800 ○ 1000 ○ 2000+ ○ Don't know

If you take calcium, how many milligrams of **calcium** do you usually take, on the days you take it? (Select the closest amount)
○ 100 ○ 350 ○ 650 ○ 1250+ ○ Don't know

If you take vitamin D, how many IUs of **vitamin D** do you usually take, on the days you take it? (Select the closest amount)
○ 400 ○ 600 ○ 800 ○ 1000 ○ 2000 ○ 3000 ○ 4000 ○ 5000+ ○ Don't know

If you take omega-3 supplements, what type do you usually take? **MARK ALL THAT APPLY**
○ Fish oil ○ Flax oil, hemp oil, other seed oil ○ Krill oil ○ Algae ○ Don't know

SOME LAST QUESTIONS ABOUT YOU

	RARELY	1-2 per WEEK	3-4 per WEEK	5-6 per WEEK	1 per DAY	1 1/2 per DAY	2 per DAY	3 per DAY	4+ per DAY
About how many servings of vegetables do you eat, not counting salad or potatoes? 1 serving = 1/2 cup.	○	○	○	○	○	○	○	○	○
About how many servings of fruit do you eat, not counting juices? 1 serving = 1/2 cup or 1 medium fruit.	○	○	○	○	○	○	○	○	○
How often do you eat foods prepared at home that are cooked or fried in **fat or oil?**	○	○	○	○	○	○	○	○	○

During a regular day, how many **meals and snacks** do you usually eat?

Meals per day	○ 1	○ 2	○ 3	○ 4	○ 5+
Snacks per day	○ 1	○ 2	○ 3	○ 4	○ 5+

PHYSICAL ACTIVITY SURVEY

Think about the last 12 months. How often did you do the activities listed below?

	HOW OFTEN IN THE PAST YEAR						HOW MUCH TIME ON THOSE DAYS			
	RARELY OR NEVER	A FEW TIMES A MONTH	ONCE OR TWICE A WEEK	3-4 TIMES A WEEK	5-6 TIMES A WEEK	ALMOST EVERY DAY	LESS THAN 30 MINUTES	30-60 MINUTES	1-2 HOURS	3 OR MORE HOURS
Cooking, shopping, light cleaning like doing laundry or dusting, or running errands	○	○	○	○	○	○	○	○	○	○
Slow walking like walking the dog, or light work around the house like watering	○	○	○	○	○	○	○	○	○	○
Work on the job involving standing, like store clerk, or work involving driving (like truck driver)	○	○	○	○	○	○	○	○	○	○
Taking care of children (feeding, dressing), or moderate housework like sweeping, mopping, cleaning the tub	○	○	○	○	○	○	○	○	○	○
Weeding, raking, mowing the lawn, or light house repairs	○	○	○	○	○	○	○	○	○	○
Brisk walking, dancing, hunting or fishing, golf (NOT using a golf cart), or 'friendly' outdoor games like softball	○	○	○	○	○	○	○	○	○	○
Factory work, mechanic, restaurant work, or work involving walking, like mail carrier	○	○	○	○	○	○	○	○	○	○
Construction, painting, feeding livestock, or homecare like caring for an adult family member	○	○	○	○	○	○	○	○	○	○
Heavy work like moving boxes, heavy digging or shoveling snow, farm chores like baling hay, or other HARD labor	○	○	○	○	○	○	○	○	○	○
Exercising at the gym or at home, aerobics, weight training, jogging, or vigorous sports like basketball, soccer, tennis	○	○	○	○	○	○	○	○	○	○
Bicycling or swimming for exercise	○	○	○	○	○	○	○	○	○	○

Are you ○ Hispanic or Latino ○ Not Hispanic or Latino ○ Do not wish to provide this information

What race do you consider yourself to be? **MARK ALL THAT APPLY**

- ○ White
- ○ Black or African American
- ○ Asian
- ○ American Indian or Alaska Native
- ○ Native Hawaiian or Other Pacific Islander
- ○ Do not wish to provide this information

Thank you very much for filling out this questionnaire.

Please take a minute to go back and fill in anything you may have skipped.

PLEASE DO NOT WRITE IN THIS AREA

○○○○○○○○○○○○○○○○○○○○○○○○○○○○

SERIAL #

1/4" SPINE PERF

Fold along this line, then carefully detach.

Fold this page along the dotted line, then CAREFULLY detach this page. Your portion pictures are on the back.

1/4" SPINE PERF

Fold along this line, then carefully detach.

Portion Size Choices

Keep this in front of you while you are filling out The Food Questionnaire. You may use either the plates or the bowls to help you choose your usual portion size.

Choose A, B, C or D: **A** = 1/4 Cup of Food **B** = 1/2 Cup of Food **C** = 1 Cup of Food **D** = 2 Cups of Food

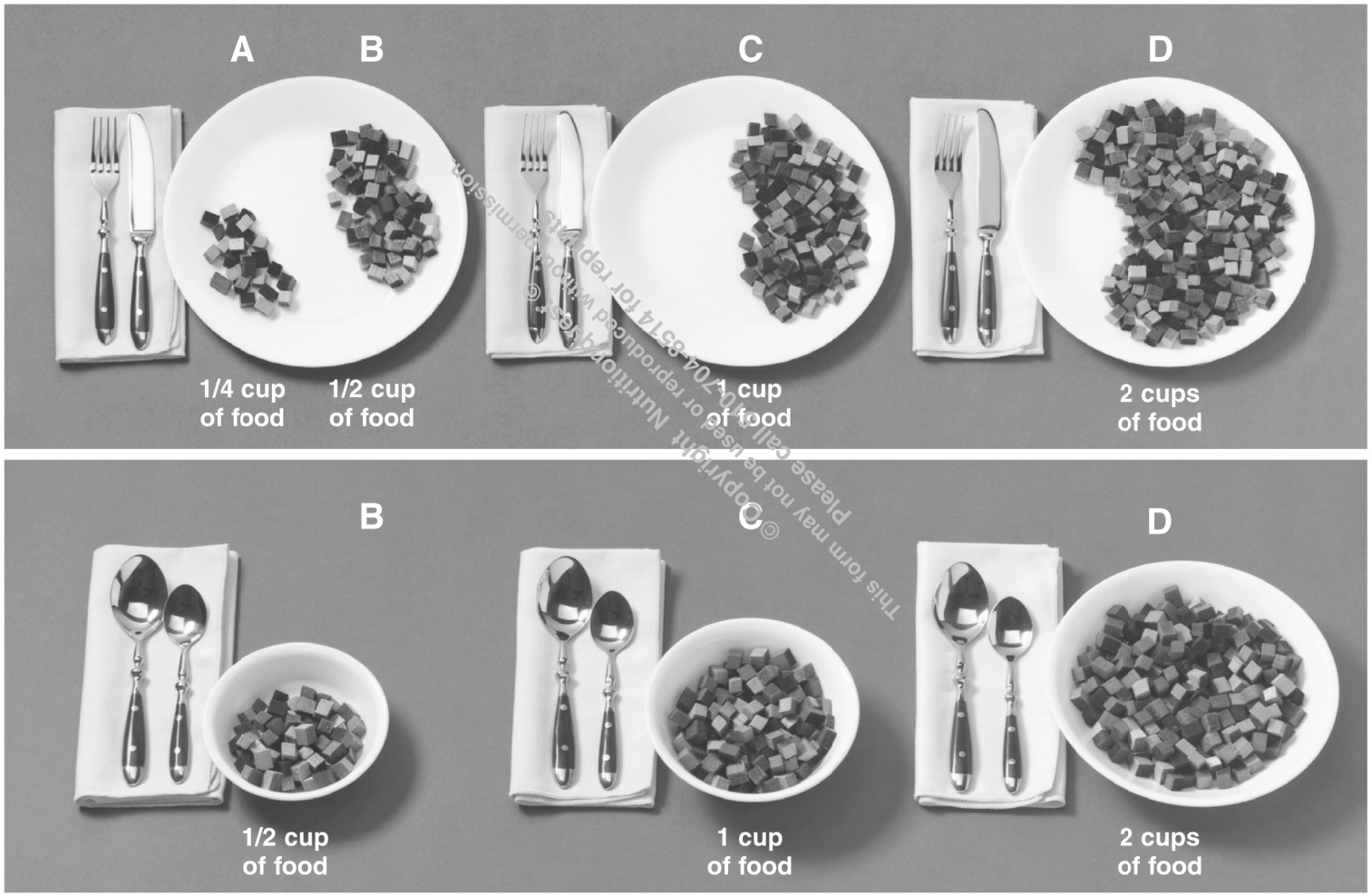


Table 4:3 Self-Report 3-day Food Log

ID # Date:_____

American Heart Association | American Stroke Association.

Food Diary

Time / Meal	Food / Beverage (type and amount)	Calories	Notes
Breakfast			
Snack			
Lunch			
Snack			
Dinner			
Snack			
TOTAL CALORIES			

ID # Date:_____

American Heart Association | American Stroke Association.

Food Diary

Time / Meal	Food / Beverage (type and amount)	Calories	Notes
Breakfast			
Snack			
Lunch			
Snack			
Dinner			
Snack			
TOTAL CALORIES			

Table 4:4 WHODAS 2.0 36-item, Self-Administered

WHODAS 2.0

WORLD **H**EALTH **O**RGANIZATION
DISABILITY **A**SSESSMENT **S**CHEDULE 2.0

36-item version, self-administered

This questionnaire asks about difficulties due to health conditions. Health conditions include diseases or illnesses, other health problems that may be short or long lasting, injuries, mental or emotional problems, and problems with alcohol or drugs.

Think back over the past 30 days and answer these questions, thinking about how much difficulty you had doing the following activities. For each question, please circle only one response.

In the past 30 days, how much difficulty did you have in:						
Understanding and communicating						
D1.1	Concentrating on doing something for ten minutes?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.2	Remembering to do important things?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.3	Analysing and finding solutions to problems in day-to-day life?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.4	Learning a new task, for example, learning how to get to a new place?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.5	Generally understanding what people say?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.6	Starting and maintaining a conversation?	None	Mild	Moderate	Severe	Extreme or cannot do
Getting around						
D2.1	Standing for long periods such as 30 minutes?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.2	Standing up from sitting down?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.3	Moving around inside your home?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.4	Getting out of your home?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.5	Walking a long distance such as a kilometre [or equivalent]?	None	Mild	Moderate	Severe	Extreme or cannot do

Please continue to next page …

In the past 30 days, how much difficulty did you have in:						
Self-care						
D3.1	Washing your whole body?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.2	Getting dressed?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.3	Eating?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.4	Staying by yourself for a few days?	None	Mild	Moderate	Severe	Extreme or cannot do
Getting along with people						
D4.1	Dealing with people you do not know?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.2	Maintaining a friendship?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.3	Getting along with people who are close to you?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.4	Making new friends?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.5	Sexual activities?	None	Mild	Moderate	Severe	Extreme or cannot do
Life activities						
D5.1	Taking care of your household responsibilities?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.2	Doing most important household tasks well?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.3	Getting all the household work done that you needed to do?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.4	Getting your household work done as quickly as needed?	None	Mild	Moderate	Severe	Extreme or cannot do

Please continue to next page …

If you work (paid, non-paid, self-employed) or go to school, complete questions D5.5–D5.8, below. Otherwise, skip to D6.1.

Because of your health condition, in the past 30 days, how much difficulty did you have in:						
D5.5	Your day-to-day work/school?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.6	Doing your most important work/school tasks well?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.7	Getting all the work done that you need to do?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.8	Getting your work done as quickly as needed?	None	Mild	Moderate	Severe	Extreme or cannot do

Participation in society						
In the past 30 days:						
D6.1	How much of a problem did you have in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.2	How much of a problem did you have because of barriers or hindrances in the world around you?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.3	How much of a problem did you have living with dignity because of the attitudes and actions of others?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.4	How much time did you spend on your health condition, or its consequences?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.5	How much have you been emotionally affected by your health condition?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.6	How much has your health been a drain on the financial resources of you or your family?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.7	How much of a problem did your family have because of your health problems?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.8	How much of a problem did you have in doing things by yourself for relaxation or pleasure?	None	Mild	Moderate	Severe	Extreme or cannot do

Please continue to next page …

H1	Overall, in the past 30 days, how many days were these difficulties present?	***Record number of days*** ____
H2	In the past 30 days, for how many days were you totally unable to carry out your usual activities or work because of any health condition?	***Record number of days*** ____
H3	In the past 30 days, not counting the days that you were totally unable, for how many days did you cut back or reduce your usual activities or work because of any health condition?	***Record number of days*** ____

This completes the questionnaire. Thank you.

Table 4.5 Spinal Cord Injury-Secondary Condition Scale (SCI-SCS): How to Use?

Spinal Cord Injury-Secondary Condition Scale (SCI-SCS): How to Use
Adapted from Kalpakjian CZ et al. Preliminary Reliability and Validity of a Spinal Cord Injury Secondary Conditions Scale, J Spinal Cord Med, 30: 131-139, 2007; Appendix A. Used with permission from Maney Publishing.

Instructions to patient:
For the following 16 health problems, please rate how much each one affected your activities and independence in the last 3 months. If you have not experienced a secondary condition in the last 3 months or if it is an insignificant problem for you, please circle ‘‘0.’’ Use the following scale to rate each of the secondary conditions.

SCI-SCS Rating System:

0 = NOT experienced in the last 3 months or is an insignificant problem.
1 = MILD or INFREQUENT problem.
2 = MODERATE or OCCASIONAL problem.
3 = SIGNIFICANT or CHRONIC problem.

Patient lD #_____ Date: _____

Health problem:	**Description:**	**Rating:**
Pressure sore(s)	These develop as a skin rash or redness and progress to an infected sore. Also called skin ulcers, bedsores and decubitus ulcers.	0 1 2 3
Injury caused by loss of sensation	Injury may occur because of a lack of sensation, such as burns from carrying hot liquids in the lap or sitting too close to a heater or fire.	0 1 2 3
Muscle spasms (spasticity)	Spasticity refers to uncontrolled, jerky muscle movements, such as uncontrolled muscle twitch or spasm. Often spasticity increases with infection or some kind of restriction, like a tight shoe or belt.	0 1 2 3
Contractures	A contracture is a limitation in range of motion caused by a shortening of the soft tissue around a joint, such as an elbow or hip. This occurs when a joint cannot move frequently enough through its range of motion. Pain often accompanies this problem.	0 1 2 3
Heterotopic bone ossification	This is an overgrowth of bone, often occurring after a fracture. Early signs include a loss of range of motion,	0 1 2 3

	local swelling and warmth at the area to the touch. This condition must be diagnosed by a physician.	
Diabetes mellitus	Diabetes is a problem resulting from irregularities in blood sugar levels. Symptoms include frequent urination and excessive thirst. This condition is diagnosed by a physician.	0 1 2 3
Bladder dysfunction	Incontinent, bladder or kidney stones, kidney problems, urine leakage and urine back up are all symptoms of bladder dysfunction. NOTE: there is a separate item for urinary tract infections.	0 1 2 3
Bowel dysfunction	Diarrhea, constipation, "accidents", and associated problems are signs of bowel dysfunction	0 1 2 3
Urinary tract infections	This includes infections such as cystitis and pseudomonas. Symptoms include pain when urinating, a burning sensation throughout the body, blood in the urine and cloudy urine.	0 1 2 3
Sexual dysfunction	This includes dissatisfaction with sexual functioning. Causes for dissatisfaction can be decreased sensation, changes in body image, difficulty in movement, and problems with bowel or bladder, like infections.	0 1 2 3
Autonomic dysreflexia	Autonomic dysreflexia, sometimes called hyperreflexia, results from interference in the body's temperature regulating systems. Symptoms of dysreflexia include sudden rises in blood pressure and sweating, skin blotches, goose bumps, pupil dilation and headache. It can also as the body's response to pain where an individual doesn't experience sensation.	0 1 2 3
Postural hypotension	This involves a strong sensation of lightheadedness following a change in position. It is caused by a sudden drop in blood pressure.	0 1 2 3
Circulatory problems	Circulatory problems involve the swelling of veins, feet or the occurrence of blood clots.	0 1 2 3
Respiratory problems	Symptoms of respiratory infections or problems include difficulty in breathing and increased secretions.	0 1 2 3
Chronic pain	This is usually experienced as chronic tingling, burning or dull aches. It may occur in an area that has little to no feeling.	0 1 2 3
Joint and muscle pain	This includes pain in specific muscle groups or joints. People who must overuse a particular muscle group, such as shoulder muscles, or who put too much strain on their joints are at risk of developing pain.	0 1 2 3

Total Score (__/48): _____

Table 4:6 Body Mass Index (BMI) Calculations

BMI Calculation

Measurement Units	Formula and Calculation
Kilograms and meters (or centimeters)	Formula: weight (kg) / [height (m)]^2 With the metric system, the formula for BMI is weight in kilograms divided by height in meters squared. Because height is commonly measured in centimeters, divide height in centimeters by 100 to obtain height in meters. Example: Weight = 68 kg, Height = 165 cm (1.65 m) Calculation: 68 ÷ (1.65)^2= 24.98
Pounds and inches	Formula: weight (lb) / [height (in)]^{2}x 703 Calculate BMI by dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703. Example: Weight = 150 lbs, Height = 5'5" (65") Calculation: [150 ÷ (65)^2] x 703 = 24.96

Adopted from CDC at http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/#Interpreted

Table 4.7 Interpretation of Body Mass Index (BMI) Results

Interpretation of BMI Results

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal or Healthy Weight
25.0 – 29.9	Overweight
30.0 and Above	Obese

Adopted from CDC at http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/#Interpreted

Table 4:8 Barbara Bates-Jensen Wound Assessment Tool (BWAT)

BATES-JENSEN WOUND ASSESSMENT TOOL
Instructions for use

General Guidelines:

Fill out the attached rating sheet to assess a wound's status after reading the definitions and methods of assessment described below. Evaluate once a week and whenever a change occurs in the wound. Rate according to each item by picking the response that best describes the wound and entering that score in the item score column for the appropriate date. When you have rated the wound on all items, determine the total score by adding together the 13-item scores. The HIGHER the total score, the more severe the wound status. Plot total score on the Wound Status Continuum to determine progress.

Specific Instructions:

1. **Size**: Use ruler to measure the longest and widest aspect of the wound surface in centimeters; multiply length x width.

2. **Depth**: Pick the depth, thickness, most appropriate to the wound using these additional descriptions:
   - 1 = tissues damaged but no break in skin surface.
   - 2 = superficial, abrasion, blister or shallow crater. Even with, &/or elevated above skin surface (e.g., hyperplasia).
   - 3 = deep crater with or without undermining of adjacent tissue.
   - 4 = visualization of tissue layers not possible due to necrosis.
   - 5 = supporting structures include tendon, joint capsule.

3. **Edges**: Use this guide:

Indistinct, diffuse	=	unable to clearly distinguish wound outline.
Attached	=	even or flush with wound base, no sides or walls present; flat.
Not attached	=	sides or walls are present; floor or base of wound is deeper than edge.
Rolled under, thickened	=	soft to firm and flexible to touch.
Hyperkeratosis	=	callous-like tissue formation around wound & at edges.
Fibrotic, scarred	=	hard, rigid to touch.

4. **Undermining**: Assess by inserting a cotton tipped applicator under the wound edge; advance it as far as it will go without using undue force; raise the tip of the applicator so it may be seen or felt on the surface of the skin; mark the surface with a pen; measure the distance from the mark on the skin to the edge of the wound. Continue process around the wound. Then use a transparent metric measuring guide with concentric circles divided into 4 (25%) pie-shaped quadrants to help determine percent of wound involved.

5. **Necrotic Tissue Type**: Pick the type of necrotic tissue that is predominant in the wound according to color, consistency and adherence using this guide:

White/gray non-viable tissue	=	may appear prior to wound opening; skin surface is white or gray.
Non-adherent, yellow slough	=	thin, mucinous substance; scattered throughout wound bed; easily separated from wound tissue.
Loosely adherent, yellow slough	=	thick, stringy, clumps of debris; attached to wound tissue.
Adherent, soft, black eschar	=	soggy tissue; strongly attached to tissue in center or base of wound.
Firmly adherent, hard/black eschar	=	firm, crusty tissue; strongly attached to wound base and edges (like a hard scab).

6. **Necrotic Tissue Amount**: Use a transparent metric measuring guide with concentric circles divided into 4 (25%) pie-shaped quadrants to help determine percent of wound involved.

7. **Exudate Type**: Some dressings interact with wound drainage to produce a gel or trap liquid. Before assessing exudate type, gently cleanse wound with normal saline or water. Pick the exudate type that is predominant in the wound according to color and consistency, using this guide:

Bloody	=	thin, bright red
Serosanguineous	=	thin, watery pale red to pink
Serous	=	thin, watery, clear
Purulent	=	thin or thick, opaque tan to yellow
Foul purulent	=	thick, opaque yellow to green with offensive odor

8. **Exudate Amount**: Use a transparent metric measuring guide with concentric circles divided into 4 (25%) pie-shaped quadrants to determine percent of dressing involved with exudate. Use this guide:

None	=	wound tissues dry.
Scant	=	wound tissues moist; no measurable exudate.
Small	=	wound tissues wet; moisture evenly distributed in wound; drainage involves $\leq$ 25% dressing.
Moderate	=	wound tissues saturated; drainage may or may not be evenly distributed in wound; drainage involves > 25% to $\leq$ 75% dressing.
Large	=	wound tissues bathed in fluid; drainage freely expressed; may or may not be evenly distributed in wound; drainage involves > 75% of dressing.

9. **Skin Color Surrounding Wound**: Assess tissues within 4cm of wound edge. Dark-skinned persons show the colors "bright red" and "dark red" as a deepening of normal ethnic skin color or a purple hue. As healing occurs in dark-skinned persons, the new skin is pink and may never darken.

10. **Peripheral Tissue Edema & Induration**: Assess tissues within 4cm of wound edge. Non-pitting edema appears as skin that is shiny and taut. Identify pitting edema by firmly pressing a finger down into the tissues and waiting for 5 seconds, on release of pressure, tissues fail to resume previous position and an indentation appears. Induration is abnormal firmness of tissues with margins. Assess by gently pinching the tissues. Induration results in an inability to pinch the tissues. Use a transparent metric measuring guide to determine how far edema or induration extends beyond wound.

11. **Granulation Tissue**: Granulation tissue is the growth of small blood vessels and connective tissue to fill in full thickness wounds. Tissue is healthy when bright, beefy red, shiny and granular with a velvety appearance. Poor vascular supply appears as pale pink or blanched to dull, dusky red color.

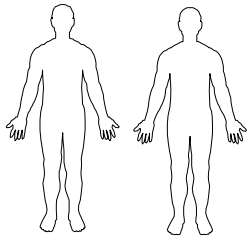
12. **Epithelialization**: Epithelialization is the process of epidermal resurfacing and appears as pink or red skin. In partial thickness wounds it can occur throughout the wound bed as well as from the wound edges. In full thickness wounds it occurs from the edges only. Use a transparent metric measuring guide with concentric circles divided into 4 (25%) pie-shaped quadrants to help determine percent of wound involved and to measure the distance the epithelial tissue extends into the wound.

BATES-JENSEN WOUND ASSESSMENT TOOL NAME

Complete the rating sheet to assess wound status. Evaluate each item by picking the response that best describes the wound and entering the score in the item score column for the appropriate date.

Location: Anatomic site. Circle, identify right **(R)** or left **(L)** and use **"X"** to mark site on body diagrams:

____ Sacrum & coccyx ____ Lateral ankle
____ Trochanter ____ Medial ankle
____ Ischial tuberosity ____ Heel Other Site



Shape: Overall wound pattern; assess by observing perimeter and depth.

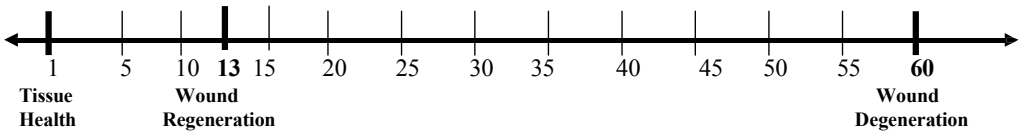
Circle and date appropriate description:

____ Irregular ____ Linear or elongated
____ Round/oval ____ Bowl/boat
____ Square/rectangle ____ Butterfly Other Shape

Item	Assessment	Date Score	Date Score	Date Score
1. Size	1 = Length x width <4 sq cm 2 = Length x width 4--<16 sq cm 3 = Length x width 16.1--<36 sqcm 4 = Length x width 36.1--<80 sqcm 5 = Length x width >80 sq cm			
2. Depth	1 = Non-blanchable erythema on intact skin 2 = Partial thickness skin loss involving epidermis &/or dermis 3 = Full thickness skin loss involving damage or necrosis of subcutaneous tissue; may extend down to but not through underlying fascia; &/or mixed partial & full thickness &/or tissue layers obscured by granulation tissue 4 = Obscured by necrosis 5 = Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone or supporting structures			
3. Edges	1 = Indistinct, diffuse, none clearly visible 2 = Distinct, outline clearly visible, attached, even with wound base 3 = Well-defined, not attached to wound base 4 = Well-defined, not attached to base, rolled under, thickened 5 = Well-defined, fibrotic, scarred or hyperkeratotic			
4. Under-mining	1 = None present 2 =Undermining < 2 cm in any area 3 = Undermining 2-4 cm involving < 50% wound margins 4 = Undermining 2-4 cm involving > 50% wound margins 5 = Undermining > 4 cm or Tunneling in any area			
5. Necrotic Tissue Type	1 = None visible 2 = White/grey non-viable tissue &/or non-adherent yellow slough 3 = Loosely adherent yellow slough 4 = Adherent, soft, black eschar 5 = Firmly adherent, hard, black eschar			
6. Necrotic Tissue Amount	1 = None visible 2 = < 25% of wound bed covered 3 = 25% to 50% of wound covered 4 = > 50% and < 75% of wound covered 5 = 75% to 100% of wound covered			
7. Exudate Type	1 = None			

Item	Assessment	Date Score	Date Score	Date Score
	2 = Bloody 3 = Serosanguineous: thin, watery, pale red/pink 4 = Serous: thin, watery, clear 5 = Purulent: thin or thick, opaque, tan/yellow, with or without odor			
8. Exudate Amount	1 = None, dry wound 2 = Scant, wound moist but no observable exudate 3 = Small 4 = Moderate 5 = Large			
9. Skin Color Surrounding Wound	1 = Pink or normal for ethnic group 2 = Bright red &/or blanches to touch 3 = White or grey pallor or hypopigmented 4 = Dark red or purple &/or non-blanchable 5 = Black or hyperpigmented			
10. Peripheral Tissue Edema	1 = No swelling or edema 2 = Non-pitting edema extends <4 cm around wound 3 = Non-pitting edema extends ≥4 cm around wound 4 = Pitting edema extends < 4 cm around wound 5 = Crepitus and/or pitting edema extends ≥4 cm around wound			
11. Peripheral Tissue Induration	1 = None present 2 = Induration, < 2 cm around wound 3 = Induration 2-4 cm extending < 50% around wound 4 = Induration 2-4 cm extending ≥ 50% around wound 5 = Induration > 4 cm in any area around wound			
12. Granulation Tissue	1 = Skin intact or partial thickness wound 2 = Bright, beefy red; 75% to 100% of wound filled &/or tissue overgrowth 3 = Bright, beefy red; < 75% & > 25% of wound filled 4 = Pink, &/or dull, dusky red &/or fills ≤ 25% of wound 5 = No granulation tissue present			
13. Epithelialization	1 = 100% wound covered, surface intact 2 = 75% to <100% wound covered &/or epithelial tissue extends >0.5cm into wound bed 3 = 50% to <75% wound covered &/or epithelial tissue extends to <0.5cm into wound bed 4 = 25% to < 50% wound covered 5 = < 25% wound covered			
	TOTAL SCORE			
	SIGNATURE			

WOUND STATUS CONTINUUM



Plot the total score on the Wound Status Continuum by putting an **"X"** on the line and the date beneath the line. Plot multiple scores with their dates to see-at-a-glance regeneration or degeneration of the wound.

Chapter 5

Results

This study examined the relationships between macronutrient and micronutrient intake, anthropometric measurements, psychosocial factors, disability status measurements, and nutritional status measurements among community dwelling non-ambulatory persons with a spinal cord injury (SCI) with and without pressure ulcers (PU's). Participants were recruited from five home health agencies and three SCI rehabilitation facilities located within Southern California. Study approvals were obtained from the Office of Human Research Protection at the University of California, Los Angeles and from the Institutional Review Board for Rancho Research Institute, Inc., Rancho Los Amigos National Rehabilitation prior to data collection.

One hundred and twenty-one (121) respondents were screened for participant eligibility in the research study. Of the 121 respondents, 23 refused or stated they were not interested in the study; eight individuals were excluded because they were unable to read English (n=3), Spanish speaking only (n=3), or able to walk (N=2). The last group (n=10) did not respond to follow up phone calls after being screened for the research study, resulting in a 66% participation rate. Figure 1 illustrates the flow of participants in the study.

The research design was a cross sectional descriptive study of 80 participants with a SCI with a PU (N=40) and without a PU (N=40). Three participants with PUs did not complete the 3-day food diaries; data analysis was completed for 77 participants to meet the aims related to macro and micro nutrient intake; 37 participants with PUs and 40 participants without PUs. Study findings are reported below. Table 1 provides the demographic characteristics and medical status of participants with and without a PU. Participants had a mean age of 47.7 years (standard deviation (SD) 11.9 years). The majority of participants were male (n=67), White/Caucasian

(n=33) and single (n=59). Most participants were unemployed (n=59) with an annual income of $25,000 or less, 40% (n=32) had some level of college education, and 24% (n=19) lived alone. Seventy percent of participants had thoracic spine injury (n=56) and 73% reported SCI duration over 10 years (n=58).

Participants ranged in height from 4ft 2inches to 6ft 2 inches and weight ranged from 90-385 pounds (one outlier of 385 pounds). Mean Body Mass Index (BMI) was 26.48 (SD= 6.35). Of those participants with a PU, 32% (n=25) had full thickness PUs (stage 3, 4, unstageable), or deep tissue injury (DTI) and 19% (n=15) had partial thickness stage 2 PUs. The following reports on the study findings for each specific aim.

Figure 5:1: Flow of Participants through Study

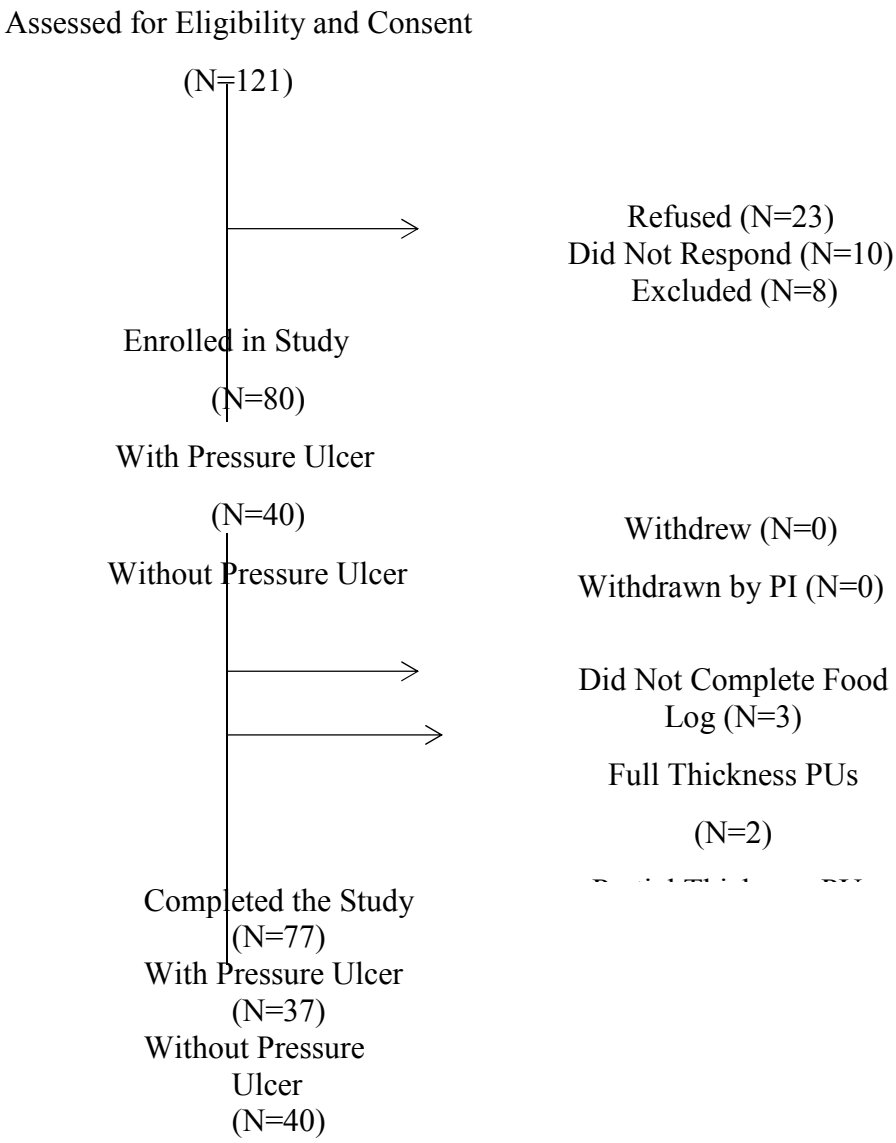


Table 5:1 Demographic and Medical Characteristics of Participants With and Without a Pressure Ulcer (PU*).*

Characteristics	All participants (n=80)	Participants with PU (n=40)	Participants without PUs (n=40)
	Mean (SD) or N (%)		
Age	44.7 (11.97)	44.40 (12.86)	45.03 (11.16)
Male	67 (83.8)	33 (83)	34 (85)
Race			
African American	32 (40)	18 (45)	14 (35)
Caucasian	33 (41)	15 (37.5)	18 (45)
Asian American	2 (2.5)	1 (2.5)	1 (2.5)
Other	13 (16.3)	6 (15)	7 (17.5)
Ethnicity			
Hispanic or Latino	34 (42.5)	15 (18.8)	19 (23.8)
Non-Hispanic or Latino	45 (56.3)	24 (30)	21(26.3)
Other	1 (1.3)	1 (1.3)	-
Marital Status			
Single	59 (73.8) *	34 (85)	25 (62)
Married	11 (13.8)	4 (10)	7 (17)
Divorced/Separated	8 (10) *	1 (2)	7 (27)
Widowed	2 (2.5)	1 (2)	1 (2)
Employment Status			
Unemployed	59 (73.8)	32 (80)	27 (67)
Employed full time	6 (7.5)	3 (7)	3 (7)
Employed part time	5 (6.3)	0 (0)	5 (12)
Retired	4 (5.0)	4 (10)	0
Student/other	6 (7.6)	1 (2)	5 (12)
Annual Income			
Less than $25,000	59 (74)	33 (41.3)	26 (32.5)
$25,000-$49,00	16 (20)	5 (6.3)	11 (13.8)
$50,000-$74,999	4 (5.0)	2 (5.0)	2 (5.0)
$75,000 or greater	1 (1.3)	-	1 (1.3)
Living Arrangements			
Living Alone	19 (23.8)	9 (22)	10 (25)
Living with spouse	9 (11.3)	3 (7)	6 (15)
Living with children	2 (2.5)	1 (2)	1 (2)
Living with other	50 (62.5)	27 (67)	23 (57)
Caregiver Presence	67 (83.8)	67(84)	13 (16)
Level of Spinal Cord Injury			

Cervical	17 (21)	5 (12)	12 (30)
Thoracic	56 (70)	34 (85)	22 (55)
Lumbar	7 (8.8)	1 (2)	6 (15)
Duration of Spinal Cord Injury			
1-2 Years	4 (5)	3 (7)	1 (2)
2-5 Years	8 (10)	8 (20)	0
5-10 Years	10 (12.5)	4 (10)	6 (15)
Over 10 Years	58 (72.5)	25 (62)	33 (82)
Bowel/Bladder Function			
Incontinent	12 (15)	4 (5)	8 (10)
Urinary Retention	52 (65)	28 (35)	24 (30)
Indwelling Catheter/urostomy	16 (20.1)	8 (10)	8 (10)
Anthropometric Measures			
Weight (lbs)	174.3 (46.81)	173.45 (51.45)	175.16 (42.31)
Height (inches)	67.64 (4.57)	68.17 (3.78)	67.10 (5.24)
Body Mass Index	26.49 (6.36)	25.92 (6.48)	27.05 (6.26)
Waist Circumference (inches)	40.09 (6.51)	39.06 (6.11)	41.12 (6.80)
Triceps Skin Fold thickness (cm)	1.18 (0.71)	1.20 (0.75)	1.16 (0.67)
Average Mid Arm Circumference (cm)	14.03 (2.07)	13.68 (2.20)	14.37 (1.88)
Pressure Ulcer Location			
Trunk (sacral, trochanter, ischial)	36 (90)	36 (90)	
Heels	4 (10)	4 (10)	
Pressure Ulcer Stages			
Stage 2	15 (19)	15 (19)	
Stage 3	16 (20)	16 (20)	
Stage 4	7 (9)	7 (9)	
Unstageable	2 (3)	2 (3)	
Deep Tissue Injury (DTI)			

***p < .05, **p < .01;**

Aim 1: Describe nutritional intake of macronutrients and micronutrients among community dwelling non-ambulatory person with a SCI with and without PU's.

Research Question 1A: Is there a relationship between macronutrient intake and micronutrient intake among community dwelling non-ambulatory SCI person with and without a PU?

Pearson Product-Moment correlations were used to test the relationship between macronutrient and micronutrient intake in participants with and without PUs. Table 2 presents the correlation matrix for participants without PUs and Table 3 presents the correlation matrix for participants with PUs. The macronutrient variables included kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber and protein intake measured using a 3-day self-report food log tested against the micronutrient variables which included vitamins A, B12, C, D, E, K, folate, and minerals calcium, iron, copper, and zinc. For both participants with and without a PU vitamin B12 and protein were significantly related to omega 6 (all p=.01). Several of the macronutrients and micronutrients relationship findings most related to wound healing are further presented.

Participants without PU: There was a relationship between macronutrient and micronutrient intake among participants without a PU. Vitamin B12 intake was strongly positively related to protein ($r = 0.89$, $p < .01$) and omega 6 fatty acid intakes, ($r = .89$, $p < .01$). Vitamin A intake was positively related to calorie and protein intake with correlation coefficients of $r = 0.36$ and $r = 0.46$, (both $p < .05$) respectively. Similarly, vitamin C and zinc intake were positively associated with, calories ($r = 0.421$, and $r = 0.508$, both $p < .01$) and proteins ($r = 0.42$ and $r = 0.58$ both $p < .01$) (Table 2).

Participants with PU: A relationship existed between macronutrient and micronutrient intake among participants with PUs. In participants with PUs, Omega 6 fatty acid intake had the strongest correlations with 11 of the 20 macronutrients. Polyunsaturated fat intake ($r = .99$, $p < .01$), omega 3 fatty acid intake ($r = .86$, $p < .01$), and vitamin B12 intake ($r = .75$, $p < .01$) were positively associated with omega 6 fatty acid intake. Calcium intake was positively associated to calories, monounsaturated fat, polyunsaturated fat, fiber, protein, Omega 3 and Omega 6 fatty acid intake with correlation coefficients ranging from $r=0.35$ to $r=0.6$ (all $p < .05$). In addition, protein intake was positively associated with Omega 3 and Omega 6 intake with correlation coefficients ranging from $r=0.33$ to $r=0.74$ (both $p < .05$) (Table 3).

.

Table 5:2 Relationship Between Macronutrient and Micronutrient Intake in Non-Ambulatory SCI Participants Without A Pressure Ulcer (N=40).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vitamin A-RAE (mcg)	1																			
Vitamin B12 (mcg)	.499**	1																		
Vitamin C (mg)	.258	.375	1																	
Vitamin D (mcg)	.151	.347*	.352*	1																
Vitamin E (mg)	.273	.132	.455**	.214	1															
Vitamin K (mcg)	.358*	.040	.248	.083	.387*	1														
Vitamin Folate (mcg	.038	.309	.194	.335*	.168	.301	1													
Minerals Calcium	.156	.348*	.476**	.331*	.112	.021	.318*	1												
Minerals Iron (mg)	.372*	.637**	.495**	.355*	.319*	.074	.480**	.581**	1											
Minerals Copper	.619**	.848**	.390*	.178	.328*	.145	.393*	.304	.678**	1										
Minerals Zinc (mg)	.164	.595**	.532**	.339*	.402*	.235	.361*	.181	.566**	.510**	1									
Calories (kcal)	.363*	.625**	.421**	.216	.404**	.085	.356*	.392*	.794**	.648**	.508**	1								
Carbohydrates (g)	.221	.248	.403**	.171	.420**	.208	.313*	.396*	.674**	.325*	.320*	.822**	1							
Saturated Fat (g)	.231	.327*	.246	.052	.457**	.153	.197	.177	.571**	.408**	.357*	.861**	.759**	1						
Monounsaturated Fat (g)	.299	.642**	.516**	.227	.436**	.142	.265	.265	.600	.667**	.703**	.713**	.367**	.506**	1					
Poly-Saturated	.467**	.846**	.300	.110	.229	-.036	.242	.213	.577**	.859**	.417**	.646**	.252	.363*	.753**	1				
Cholesterol (mg)	.334*	.573**	.562**	.457**	.475**	.195	.409**	.305	.619**	.583**	.697**	.732**	.453**	.636**	.779**	.519**	1			
Fiber (g)	-.075	-.099	.026	-.006	.194	.086	.357**	.317*	.333*	.113	-.026	.270	453**	.303	-.120	-.146	.095	1		

Protein (g)	.464**	.888**	.417**	.269	.226	.006	.366*	.424**	.755**	.845**	.585**	.838**	.468**	.561**	.741**	.810**	.714**	.364	1	
Omega 3	.449**	.819**	.225	.079	.040	-.006	.240	.200	.424**	.781**	.285	.482**	.167	.226	506**	.885**	.373**	-.180	.675**	1
Omega 6	.509**	.886**	.237	.169	.058	-.035	.258	.242	.534**	.851**	.344*	.580**	.194	.297	.609**	.954**	.477**	-.159	.790**	.931**

*p < .05, **p < .01; Pearson Product Moment Correlations. Red font indicates nutrients most associated with wound healing (Wermick & Stawicki 2018).

Table 5:3 Relationship Between Macronutrient Intake and Micronutrient Intake in Non-Ambulatory SCI Individuals With Pressure Ulcer (N=37).

	1	2	3	4	5)	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vitamin A-RAE (mcg)	1																			
Vitamin B12 (mcg)	.040	1																		
Vitamin C (mg)	.288	-.013	1																	
Vitamin D (mcg)	-.114	.013	-.167	1																
Vitamin E (mg)	.346*	.059	.058	-.020	1															
Vitamin K (mcg)	.273	.172	-.30	-.066	.597*	1														
Vitamin Folate (mcg)	.261	.160	.283	-.001	.483**	.463**	1													
Minerals Calcium (mg)	.270	.433**	.230	0.072	.346*	.375*	.555**	1												
Minerals Iron (mg)	.323	.393*	.269	-.100	.394*	.365*	.667**	.764**	1											
Minerals Copper (mg)	.133	.820**	.093	-.091	.438**	.387*	.330*	.460**	.493**	1										
Minerals Zinc (mg)	-.038	.472**	.194	-.055	.152	.125	.100	.017	.035	.565**	1									
Calories (kcal)	.248	.276	.213	-.200	.250	.135	-.015	.346*	.483**	.258	.116	1								
Carbohydrates (g)	.241	.127	.387*	-.202	.240	.052	.093	.302	.452**	.209	.144	.872**	1							
Saturated Fat (g)	.003	-.116	.008	-.125	-.106	-.030	-.261	-.067	-.093	-.110	-.068	.166	.131	1						
Monounsaturated Fat (g)	.133	.491**	-.023	-.058	.682**	.570**	.396*	.422**	.561**	.609**	.166	.555**	.337	-.017	1					
Polyunsaturated Fat (g)	.034	.745**	-.050	.034	.293	.266	.264	.424**	.614**	.682**	.209	.571**	.410*	-.073	.752**	1				
Cholesterol (mg)	.206	-.012	-.015	-.164	.010	-.020	-.342*	.000	.009	-.158	0.27	.440**	.288	.099	.080	-.089	1			

Total Dietary Fiber (g)	.390*	.163	.518**	-.100	.394*	.168	.520**	.599**	.731**	.319	.142	.572**	.642**	.006	.317	.403*	-.029	1		
Protein (g)	.148	.576**	.093	-.063	.083	.138	.024	.495**	.410*	.303	.043	.738**	.478**	.068	.559**	.633**	.362*	.328*	1	
Omega 3	-.008	.728**	-.081	.146	.093	.172	.175	.457**	512**	612**	.250	.383*	.265	-.113	.483**	.875**	-.144	.290	.555**	1
Omega 6	.035	.747**	-.054	.027	.275	.248	.238	.380*	.581**	.674**	.202	.553**	.397*	-.065	.740**	.995**	-.102	.370*	.617**	.863**

*p < 0.05, **p < 0.01; Pearson Product Moment Correlations. Red font indicates nutrients most associated with wound healing (Wermick & Stawicki 2018).

A multiple logistic regression analysis was conducted using the variables vitamin D, polyunsaturated fat, saturated fat, zinc, and omega 6 intake to evaluate how well macro and micronutrients predicted the outcome of participants with and without a PU. These variables were chosen because of the strong correlation between micro and macronutrient in participants with and without PUs. None of the variable vitamin D, polyunsaturated fat, saturated fat, zinc, and omega 6 was a significant predictor of participants with or without a PU and the model only explained 25.3% of the variance in-group membership (with or without a PU) ($R^2 = 0.06$; p=.73).

A relationship existed with macro and micronutrients intake among participants with and without PU. Vitamin B12 intake was significantly related to omega 6 fatty acid intake. However, none of the macro and micronutrients intake was a significant predictor of those participants with and without a PU.

Research Question 1B: Is there a difference in macronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU?

Independent-sample t-tests were conducted to evaluate differences in macronutrient intake among participants with and without PUs. There was no significant difference in the 3-day average intake of macronutrients between participants with and without a PU. Table 4 presents the results of differences in macronutrient intake for participants with and without a PU.

Table 5:4. Differences in Macronutrient Intake among Community Dwelling Non-Ambulatory Spinal Cord Injury Participants with (n=37) and without Pressure Ulcers (n=40).

	Pressure Ulcer (PU)	Mean (SD)	t	P value	95% Confidence Interval Lower--Upper
Calories (kcal)	Without PU	1968.64 (713.74)	-1.36	.178	-562.33--106.16
	With PU	2196.73 (758.56)			
Carbohydrates (g)	Without PU	228.02 (69.17)	-.74	.463	-51.06--23.46
	With PU	241.82 (93.97)			
Saturated Fat (g)	Without PU	25.29 (11.39)	-1.49	.139	-16.46--2.34
	With PU	32.35 (27.42)			
Monounsaturated Fat (g)	Without PU	14.20 (11.72)	-1.03	.304	-8.78--2.77
	With PU	17.20 (13.71)			
Polyunsaturated Fat (g)	Without PU	8.88 (10.82)	-1.41	.161	-8.38--1.42
	With PU	12.36 (10.75)			
Cholesterol (mg)	Without PU	323.27 (193.85)	-.72	.472	-120.24--56.25
	With PU	355.26 (194.59)			
Total Dietary Fiber (g)	Without PU	14.01 (7.51)	-1.72	.088	-6.0--.43
	With PU	16.83 (6.76)			
Protein (g)	Without PU	85.59 (47.04)	-.96	.340	-31.02--10.83
	With PU	95.68 (44.97)			
Omega 3 (g)	Without PU	.768 (1.29)	-1.55	.125	-.973--.12
	With PU	1.19 (1.29)			
Omega 6 (g)	Without PU	6.20 (9.41)	-1.80	.076	-8.22--.42
	With PU	10.11 (9.61)			

Research Question 1C: Is there a difference in micronutrient intake among community dwelling non-ambulatory person with a SCI with and without a PU?

Independent-sample t-tests were conducted to evaluate micronutrient intake differences among participants with and without PUs. There were no significant differences in micronutrient intake among participants with and without PUs. Vitamin D and vitamin K consumption for participants with a PU was greater than for participants without a PU. Participants with PUs reported vitamin D intake of 225.2 units and vitamin K intake of 77.20 mcg compared to participants without PUs who consumed 7 times lower amounts of vitamin D 32.8 units and approximately half the vitamin K intake (43.79 mcg, both p=.01) over the 3-days. Table 5 presents results of differences in micronutrient intake for participants with and without a PU.

Table 5:5. Differences in Micronutrients Intake among Community Dwelling Non-Ambulatory Spinal Cord Injury Participants with (n=37) and without Pressure Ulcers (n=40).

	Pressure Ulcer (PU)	Mean (SD)	t	p	95% CI Lower--Upper
Vitamin A-RAE (mcg)	Without PU	286.80 (289.40)	-.66	.51	-194.72--134.76
	With PU	342.47 (443.81)			
Vitamin B12 (mcg)	Without PU	2.76 (3.32)	-.19	.85	-1.42--1.56
	With PU	2.91 (3.44)			
Vitamin C (mcg)	Without PU	75.48 (55.46)	-.78	.44	-37.16--25.47
	With PU	87.92 (82.44)			
Vitamin D (units)	Without PU	32.8 (11.04)	-1.3	.2	-11.51--2.72
	With PU	225.2 (938.8)			
Vitamin E (mg)	Without PU	3.02 (3.19)	-.04	.97	-.99--1.40
	With PU	3.04 (1.98)			
Vitamin K (mcg)	Without PU	43.79 (73.39)	-1.66	.01	-66.77--11.53
	With PU	77.20 (102.28)			
Vitamin Folate (mcg	Without PU	167.84 (95.59)	-1.07	.29	-113.19--86.03
	With PU	192.53 (106.39)			
Minerals Calcium (mg)	Without PU	447.99 (196.12)	-1.08	.28	-782.76--5.60
	With PU	499.00 (218.24)			
Minerals Iron (mg)	Without PU	10.36 (4.83)	-1.38	.173	-3.13--1.73
	With PU	11.95 (5.34)			
Minerals Copper (mg)	Without PU	.48 (.39)	-1.85	.23	-.42--.07
	With PU	.70 (.66)			
Minerals Zinc (mg)	Without PU	5.06 (4.58)	-1.65	-4.03	-8.08--1.37
	With PU	9.09 (14.68)			

Aim 2: Describe and evaluate the relationship of psycho-social factors, anthropometric measurements, nutrition status measurement, and disability status measurements among community dwelling non-ambulatory person with a SCI with and without a PU

Research Question 2A: What is the relationship between psychosocial factors, nutrition status measurements, and disability status measurements among community dwelling non-ambulatory person with a SCI with and without a PU?

Pearson Product-Moment Correlations were performed to test the relationships between psychosocial factors, nutrition status measurements, and disability status measurements among participants with and without a PU. Psychosocial variables examined were: living condition, grocery shopping ability, cooking ability, medications, smoking habits, and duration of spinal cord injury. Nutrition status measurement consisted of the total score from the Mini Nutrition Assessment (MNA). Disability measures were derived from the World Health Organization Disability Assessment Schedule (WHODAS) total score and Spinal Cord Injury Secondary Conditions Scale (SCI-SCS) total score. Disability measures consisted of WHODAS total score, a measure of six domains of life during the previous 30 days, and SCI-SCS total score, based on 16 items that evaluate chronic problems affecting activity and independence in the last ninety days. Nutrition status measurement was the total score from (MNA), based on six questions on anthropometric measurement, intestinal motility, food intake, and acute diseases and neurological problems. For both participants with and without a PU, education level and employment were significantly related to annual income (all $p=.01$). Correlations specific to each group are presented below.

Participants with PU: Seven variables were significantly related at a level of $p \leq .05$ with coefficients greater or equal to 0.26. "Who does the cooking" was related to education level

(r=0.27, p=.05), employment status (r=0.26, p=.05) and "who does the grocery shopping" (r=0.71, p=.01). "Who does the grocery shopping" was negatively and moderately related to education (r=-0.26, p=.05) and employment (r=-0.28, p=.05). The SCI-SCS total score was significantly related to the WHODAS total score (r=0.46, p=.01). The Mini Nutritional Assessment score was negatively and moderately related to race (r=-0.41, p=.01). No other psychosocial factors, disability status measurements, or nutrition status variables were significantly related in participants with PU.

Participants without PU: Six variables were significantly related at a level of $p \leq .05$ with coefficients greater or equal to 0.33. WHODAS total score was negatively related to employment (r=-0.38, p=.05), and level of SCI (r=-0.40, p=.05). WHODAS total score was positively related to "who does the cooking" (r=0.33, p=0.05), race (r=0.35, p=.05) and SCI-SCS total score (r=0.40, p=.05). SCI-SCS total score was also related to "who does the cooking" (r=0.33, p=.05). Employment was negatively associated with "who does the grocery shopping" and "who does the cooking" (both r=-0.39, p=.05). No other psychosocial factors, disability status measurements, or nutrition status variables were significant.

A binary logistic regression analysis was conducted using group membership (with or without PUs) as the outcome and "who does the cooking", WHODAS total score, and SCI-SCS total score as predictors. "Who does the grocery shopping" was not included in the model due to the high correlation with "who does the cooking" among participants with PUs (r=0.71). The SCI-SCS total score was a significant predictor of participants with or without a PU (p=.01) with an odds ratio of 1.13 (95% confidence interval [CI] 1.025—1.261). Who does the cooking" had an odds ratio of 1.39 (95% CI 0.870—2.22, p=.168). WHODAS total score was not significant in the model. Results are displayed in Table 6.

Table 5:6. Summary Statistics for the Model of Community Dwelling Non-Ambulatory Spinal Cord Injury Participants With a Spinal Cord Injury With And Without a Pressure Ulcer (PU) Using Psychosocial And Disability Measures As Predictors (N=80*)*

Predictor	b^s	Wald	p	OR	95% CI Lower--Upper
WHODAS	-.003	.11	.74	.74	.95—1.03
SCI-SCS	.13	5.89	**.01**	1.14	1.02—1.26
Cooking	.33	1.9	.17	1.39	.87—2.22
Constant	-2.64	6.87	.01	.07	
-2 Log likelihood	100.44[a]				
Model Chi-square (df=1)	10.47				
p	.01				
Overall rate of Correction Classification	16.4%				

Note. b^s Unstandardized logistic regression coefficient

A relationship existed with psychosocial factors among participants with and without a PU. "Who does the cooking" and "who does the grocery shopping" were significantly related to education and employment of participants. The SCI-SCS total score was a significant predictor of participants with or without a PU.

Research Question 2B: Is there a difference in psychosocial factors among community dwelling non-ambulatory person with a SCI with and without a PU?

Chi-Square and independent-sample t-tests were conducted to determine differences with psychosocial factors between participants with and without PU. The variables analyzed were: living condition, grocery-shopping ability, cooking ability, medications, smoking habits, caregiver, level of spinal cord injury, and duration of spinal cord injury. There were significant differences in psychosocial factors between participants with and without PU. Eighteen percent of participants with a PU did not do their own cooking, compared to 82% of participants without

a PU did do their own cooking (p=.05). Living condition, grocery-shopping ability, medications, smoking habits, caregiver, level of spinal cord injury, and duration of spinal cord injury were not significantly different between participants with and without PUs.

Research Question 2C: Is there a difference in anthropometric measures among community dwelling non-ambulatory person with a SCI with and without a PU?

Independent-sample t-tests were conducted to evaluate differences in anthropometric variables and to determine any significant differences in anthropometric BMI, triceps skin fold, waist circumference variables between participants with PUs and those without PUs. There were no significant differences in anthropometric measures between participants with and without PUs. Participants with a PU had lower overall BMI scores (Mean BMI Score = 25.92; SD = 6.48) than those without PU (Mean BMI Score = 27.05; SD =6.26) but this was not significant. Participants with a PU also had a smaller waist circumference (mean waist circumference = 39.06 cm, SD 6.11cm) compared to those without PU (mean waist circumference = 41.12 cm, SD = 6.80cm) although not significant. Results are displayed in Table 7.

Table 5:7. Anthropometric Score Differences between Community Dwelling Non-Ambulatory Spinal Cord Injury Participants with and without Pressure Ulcers (N=80).

	Pressure Ulcer (PU)	Mean (SD)	p	95% CI Lower--Upper
Body Mass Index (BMI)	Without PU	27.05 (6.26)	.93	-1.70--3.97
	With PU	25.92 (6.48)		
Triceps Skin Folds (centimeters)	Without PU	1.16 (.67)	.68	-.36--.27
	With PU	1.20 (.75)		
Waist Circumference (centimeters)	Without PU	41.12 (6.80)	.52	-.81--4.94
	With PU	39.06 (6.11)		

Mid-arm Circumference (centimeters)	Without PU	14.37 (1.88)	.81	-.22--1.60
	With PU	13.68 (2.20)		

Research Question 2D: Is there a difference in nutrition status measurement (Total MNA Score) among community dwelling non- ambulatory person with a SCI with and without a PU?

An independent-samples t-test was conducted to evaluate total MNA score differences between participants with PUs and those without PUs. There were no significant differences in the MNA total score between participants with and without PUs. Participants with a PU on the average had lower overall MNA scores (Mean MNA Score = 12.55; SD = 1.60) than those without PUs (Mean MNA Score = 12.83; SD =1.58) but this was not significant (p=.44).

Aim 3: Describe and evaluate the relationship between macronutrients intake, micronutrients intake, anthropometric measurements, psycho-social factors, nutrition status measurement, and disability status measurements among community dwelling non-ambulatory person with a SCI with a Partial Thickness PU (Stage 2 PU) versus Full Thickness PU (Stage 3, 4, or Unstageable PU)

Participants with PUs had a mean Bates-Jensen Wound Assessment Tool (BWAT) total score of 27.93 (SD 5.86) with a range from 17 to 43. Participants with stage 2 PUs (n=15) accounted for 37.5% of PUs. Those participants with a stage 3 PUs (n=16) accounted for 40% of the PUs and 11% of participants had stage 4 or unstageable PUs (n=9). Most participants (40%) had a PU located on the sacrum, coccyx, or trochanter (n=16) and 35% had a PU on the ishial tuberosity (n=14). Only 10% of participants had PUs on the heels. Forty five percent of participants had a PU ranging in size from 4 to 16 square centimeters (n=32). Undermining was present in 15% of the PUs (n=6) and these PU's also presented with yellow necrotic slough. Serosanguinous drainage was present in 65% (n=26) of the PUs and 50% (n=20) had a moderate to large amount of exudate.

Research question 3A: What is the relationship between macronutrient intake, micronutrient intake, among community dwelling non-ambulatory persons with a SCI with a partial thickness PU versus full thickness PU?

Three participants with PUs did not complete the 3-day food diary (2=full thickness PU and 1= partial thickness PU), thus, data were analyzed with 37 participants for examining macronutrient and micronutrient intake. Pearson Product-Moment Correlations were performed to evaluate macronutrient and micronutrients relationships among participants with a partial

thickness PU (Table 8) and among those with full thickness PUs (Table 9). The macronutrient variables included kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber and protein intake measured using a 3-day self-report food log and the micronutrient variables included vitamins A, B12, C, D, E, K, folate, and minerals calcium, iron, copper, and zinc. For both participants with partial and full thickness PU, fiber intake was significantly related to calcium intake ($r =. 84$; $r = .46$, respectively, both $p<.05$) and iron intake ($r = .85$; $r = .69$, respectively, both $p<.01$). Monounsaturated fat intake was significant with vitamin E intake ($r = .71$; $r = .69$, respectively, both $p<.01$), vitamin K intake ($r = .56$; $r= .59$, respectively, both $p<.01$) and vitamin B12 intake ($r =.73$; $r = .420$, respectively, both $p<.05$). Correlations specific to each group are further presented below.

Participants with Partial Thickness PU: There was a relationship between macronutrient and micronutrient intake among participants with a partial thickness PU. Vitamin B12 intake was positively and strongly related to monounsaturated fat, polyunsaturated fat, protein, and Omega 3 and Omega 6 fatty acid intake with correlation coefficients above $r=0.73$ (all $p < .01$). Iron intake was positively and moderately associated with carbohydrates, polyunsaturated fat, fiber, proteins, Omega 3 and Omega 6 fatty acid and calorie intake (all coefficients above $r = 0.53$; all $p < .05$).

Participants with Full Thickness PU: A strong relationship existed between macronutrient and micronutrient intake among participants with full thickness PU. In participants with full thickness PUs, Vitamin B12 intake was positively and moderately associated to monounsaturated fat, polyunsaturated fat, protein, Omega 3 and Omega 6 fatty acid intake with correlation coefficients ranging from $r=0.42$ to $r=0.7$ (all $p< .05$). Similar to participants with partial thickness PUs, iron intake was also positively associated with calories, ($r = 0.46$, $p< .05$)

monounsaturated fats (r=0.51, p=.01), polyunsaturated fats (r=0.6, p=.01), fiber (r=0. 68, p=.01), Omega 3 fatty acid (r=0. 52, p=.05) and Omega 6 fatty acid intake (r = 0.57, p=.01).

Table 5:8 Relationship between Micronutrients and Macronutrients Among Persons with SCI with Partial Thickness Pressure Ulcers (N=14).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Vitamin A-RAE (mcg)	1																				
Vitamin B12 (mcg)	.313	1																			
Vitamin C (mg)	.312	.343	1																		
Vitamin D (mcg)	-.316	.042	-.252	1																	
Vitamin E (mg)	.278	.292	-.131	.041	1																
Vitamin K (mcg)	.204	.132	-.005	-.091	.802**	1															
Vitamin Folate (mcg	.637*	.381	.528	-.038	.522	.421	1														
Minerals Calcium (mg)	.465	.647*	.703**	-.260	.212	.216	.572*	1													
Minerals Iron (mg)	.567*	.715**	.652*	-.255	.215	.114	.611*	.875**	1												
Minerals Copper (mg)	.504	.856**	.388	-.140	.603*	.541*	.670**	.703**	.719**	1											
Minerals Zinc (mg)	.436	.533*	.156	-.038	.707**	642***	.639**	.637**	.651*	.757**	1										
Calories (kcal)	.316	.477	.061	.-.337	.169	-.117	-.075	.478	.535*	.341	.247	1									
Carbohydrates (g)	.388	.354	.285	-.344	.092	-.097.1	.083	.480	.543*	.236	.126	.861**	1								
Saturated Fat (g)	.150	.263	-.360	-.397	.051	.097	-.395	.155	.170	.141	.118	.795**	.450	1							
Monounsaturated Fat (g)	.476	.734**	-.059	-.092	.710**	.558*	.408	.458	.513	.855**	.697**	.502	.243	.483	1						
Polyunsaturated Fat (g)	.323	.935**	.229	.084	.360	.090	.361	.590*	.666**	.807**	.465	.619*	.474	.368	.785**	1					
Cholesterol (mg)	-.130	-.115	-.357	-.247	-.323	-.455	.691**	-.284	-.089	-.395	-.334	.511	.355	.659*	-.092	-.067	1				
Fiber (g)	.393	.503	.813**	-.140	.001	-.151	.522	.845**	.846**	.440	.340	.486	.635*	-.021	.148	.508	.779**	1			
Protein (g)	.226	.741**	.080	-.203	.224	-.028	-.010	.509	.604*	.565*	.380	.889**	.682**	.716**	.659*	.814**	.423	.434	1		
Omega 3	.200	.915**	.238	.290	.271	-.005	.334	.504	.566*	.710**	.369	.463	.423	.153	.620*	.945**	-.157	.487	.690**	1	
Omega 6	.322	950**	.237	.082	.364	.122	.372	.574*	.644*	.831**	.469	.571*	.447	.321	.781**	.993**	-.102	.474	.798**	.955**	1

** Correlation is significant at 0.01 level (2-tailed) * Correlation is significant at 0.05 level (2-tailed)

Table 5:9 Relationship between Micronutrients and Macronutrients Among Persons with SCI with Full Thickness Pressure Ulcers (N=23).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Vitamin A-RAE (mcg)	1																				
Vitamin B12 (mcg)	-.013	1																			
Vitamin C (mg)	.299	-.152	1																		
Vitamin D (mcg)	.009	.099	-.056	1																	
Vitamin E (mg)	.351	-.018	.128	-.065	1																
Vitamin K (mcg)	.335	.199	-.057	.090	.524*	1															
Vitamin Folate (mcg)	.192	.090	.135	.128	.496*	.511*	1														
Minerals Calcium (mg)	.250	.382	-.014	.484*	.416*	.506	.547*	1													
Minerals Iron (mg)	.299	.316	.089**	.130	.484	.557**	.701**	.715**	1												
Minerals Copper (mg)	.059	.809**	-.026	-.050	.379	.337	.219	.401	.449*	1											
Minerals Zinc (mg)	-.089	.483*	.223	-.060	.083	.068**	.071	-.025	.007	.571**	1										
Calories (kcal)	.253	.217	.305	-.060	.297	.335**	.020	.278	.460*	.241	.130	1									
Carbohydrates (g)	.227	.061	.447*	-.166	.309	.225	.097	.218	.411	.212	.178	.879**	1								
Saturated Fat (g)	-.018	-.172	.076	-.126	-.149	-.028	-.263	-.104	-.133	-.157	-.095	.068	.091	1							
Monounsaturated Fat (g)	.058	.420*	-.006	-.002	.686**	.592**	.392	.409	.591**	.536**	.132	.585**	.385	-.111	1						
Polyunsaturated Fat (g)	-.027	.696**	-.180	.033	.265	.380	.228	.368	.607**	.648**	.197	.560**	.391	-.145	.744**	1					
Cholesterol (mg)	.309	.015	.205	.094	.139	.345	-.102	.173	.076	-.089	.046	.404	.261	-.016	.182	-.112	1				
Fiber (g)	.432*	.033	.319	-.079	.528**	.449*	.521*	.464*	.687**	.284	.149	.632**	.655**	.012	.424*	.362	.059	1			
Protein (g)	.140	.536**	.100	.400	.034	.260	.042	.489*	.327	.224	.019	.660**	.382	-.037	.510*	.567**	.333	.268	1		
Omega 3	-.055	.685**	-.208*	.404	.026	.261	.134	.465*	.524*	.582*	.231	.376	.231	-.157	.452**	.863**	-.169	.231	.532**	1	
Omega 6	-.028	.693**	-.196	-.011	.238	.332	.183	.311	.570*	.628**	.186	.554**	.382	-.133	.727**	.996**	-.117	.325	.547**	.845**	1

** Correlation is significant at 0.01 level (2-tailed) * Correlation is significant at 0.05 level (2-tailed)

A multiple logistic regression analysis was conducted using the variables most related to wound healing; vitamin B12, iron, zinc, vitamin D, and protein intake, as predictors of partial versus full thickness PUs as a two-level outcome. None of the variables (B12, iron, zinc, vitamin D, or protein), were significant predictors of the occurrence of partial thickness versus full thickness PUs and the model only explained 12.3% of the variance in the group membership (partial thickness or full thickness) ($R^2 = 0.18$; p= .89).

A relationship existed with macro and micronutrients among participants with partial and full thickness PU. In both groups, fiber intake was related to calcium and iron intake, monounsaturated fat intake was related to vitamins E, K, and B12 intake. However, none of the variables were predictors of participants with partial and full thickness PU.

Research Question 3B: Is there a difference between macronutrient intake, micronutrient intake, anthropometric measurements, psycho-social factors, and disability status measurements among community dwelling non-ambulatory persons with a SCI with a partial thickness PU versus full thickness PU?

Independent-sample t-tests were conducted to evaluate differences in macronutrient intake (kilocalories (kcal), carbohydrates, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, fiber and protein), and micronutrient intake (vitamins A, B12, C, D, E, and K, folate, calcium, iron, copper, and zinc) between participants with partial thickness PUs versus full thickness PUs. There were no significant differences in macro and micronutrient intake among participants with a partial thickness PU compared to participants with full thickness PUs.

Participants with a full thickness PU had lower overall vitamin D intake (85.2 units SD = 170.8 units) than those with a partial thickness PU (413.6 units mcg, SD = 1468 units) but this was not significant (p= .28). Participants with a full thickness PU consumed almost three times

greater amounts of zinc compared to participants with partial thickness PUs (11.64mg SD 18.12mg, 4.91mg, SD 3.37, respectively, p=.18). Participants with full thickness PUs also consumed more Omega 6 fatty acids (9.76mg, SD 10.52mg) compared to participants with partial thickness PUs (8.67mg, SD 8.21mg) although not significant. Participants with full and partial thickness PUs consumed nearly equal amounts of proteins, calories, iron, and cholesterol.

Independent sample t-tests were conducted to examine differences in anthropometric measurements (BMI triceps skin folds, mid-arm circumference, and waist circumference) between participants with partial thickness versus full thickness PUs and there were no significant differences between groups.

Independent sample t-tests were conducted to explore disability status measurement (WHODAS total score and SCI-SCS total score) differences between participants with partial thickness versus full thickness PU. There were no significant differences in disability status measurements between participants with a partial thickness PU compared to those with full thickness PUs.

Chi Square tests were conducted to determine any significant differences in psychosocial variables between participants with partial thickness PU versus full thickness PU. The psychosocial variables were living condition, grocery shopping ability, cooking ability, medications, smoking habits, and duration of spinal cord injury. There was no significant difference in any of the psychosocial variables between participants with partial thickness PU versus full thickness PU (all $p < .05$).

Research Question 3C: Is there a difference in nutritional status (Total MNA Scores) among community dwelling non-ambulatory person with a SCI with a partial thickness PU versus full thickness PU?

Two tests were conducted to assess whether nutrition status measurements using the total MNA score and the individual MNA items were different between participants with a partial thickness PU versus full thickness PU. An Independent-sample t-test was performed to evaluate differences with the total MNA scores between participants with a partial thickness PU versus full thickness PU, and there was no significant difference in MNA total score between participants with partial thickness PU versus full thickness PU, ($p < .05$). Chi-Square analyses were conducted to determine any significant differences with the individual items from the MNA between participants with a partial thickness PU versus full thickness PU. There was no significant difference in MNA individual items between participants with partial thickness PUs compared to those with full thickness PUs.

In conclusion, the study results indicated that there is a positive and strong relationship between micronutrient and macronutrient intake among the 77-community dwelling non-ambulatory participants with a SCI with and without PUs. Zinc, vitamin B12, and omega 6 fatty acid intake demonstrated the strongest relationship with macronutrient intake of polyunsaturated fat, calories, and protein among participants with and without a PU. Further, the findings of this research study indicated that, for both participants with and without PU, the vitamin D intake was well below the recommended daily allowance. Exposure to sunlight, leading to cutaneous production, and the ingestion of food sources are the two mechanisms by which vitamin D can be obtained and stored within the human body. A low vitamin D status is of particular concern in the spinal cord injury population, given the poor intake of rich dietary sources coupled with the probable indoor lifestyle and limited exposure to sunlight. A vitamin D deficiency can lead to many pathological conditions, including osteomalacia/rickets, osteoporosis, and muscle weakness resulting in an increased risk of falls and fractures. Additionally, studies have

suggested that vitamin D has an immune modulating effect, enhancing monocyte mycobacterial destruction by facilitating the production of the antimicrobial protein, cathelicidin (Li et al. 2006). Consequently, suboptimal levels of vitamin D have been associated with an increased risk of autoimmune deficiency and the development of infectious diseases (Brinkley, et al., 2010).

The findings of this research study also found that participants without PUs consumed approximately half the vitamin K intake (43.79 mcg, both p=.01) over the 3-days. While vitamin K is more often associated with blood coagulation, it also plays a role in bone metabolism and bone-related diseases. Studies suggest that there is an inverse relationship between dietary intake of vitamin K and risk of fractures. A vitamin K deficiency is associated with osteoporosis, pathological fractures, and vascular calcification (Shearer et al., 2012), which is of additional concern in the spinal cord injury population at risk for bone demineralization and vascular abnormalities.

Relationships between psychosocial factors, anthropometric, nutritional status, and disability among participants demonstrated no significant differences. Although, there was not a significant difference with psychosocial factors, there was a weakly positive correlation between psychosocial factors, “Who does the cooking” and “Who does the grocery shopping”, with education and employment in comparing participants with and without PUs. The findings suggest that those participants without a PU may be eating healthier, consuming lower amounts of calories, carbohydrates, fat, and sugars than those participants with a PU, who do their own shopping and cooking. In addition, the research found that the total score from the SCI-SCS was a predictor for participants with and without a PU, indicating that health and physical function is impacted by these secondary conditions.

Chapter 6

Discussion

In this study of nutrition among community dwelling non-ambulatory persons with a spinal cord injury (SCI) with and without pressure ulcers (PUs), we found significant and clinically meaningful differences in macro and micro nutrient intake. Protein intake was generally higher than the Recommended Dietary Guidelines for Americans (RDA) of 56 grams per day. Sixty one percent (n=47) of all participants consumed above the RDA for protein. Participants without a PU consumed 85 grams of protein per day and participants with a PU consumed 95 grams of protein. A study by Groah and colleagues (2009) with 73 participants with SCI (male =61, and female =12) found protein intake was generally within the recommended range (46-56 grams of protein per day) which is much lower than the protein intake among our study participants.

Persons with SCI with PUs, along with the able-bodied population with PUs, require adequate protein intake in order to heal. When dietary protein intake increases, the outcome for all stages of PUs have been linked to improved healing rates (Posthauer, Banks, Dorner, & Schools, 2015). The National Pressure Ulcer Advisory Panel (NPUAP) PU treatment guidelines recommend individuals with PUs consume high protein nutritional supplements in addition to dietary protein consumption of 1.25 – 1.5 g/kg/day. In this study, 50% of participants with PUs consumed less than NPUAP recommended protein consumption. A study by Ohura and colleagues (2011) of 30 participants with SCI in a control group and 30 participants with SCI in a nutritional intervention group evaluated the effects of higher than recommended protein

(162g/kg/day) intake on PU healing. They found those participants consuming higher than the recommended protein levels demonstrated improved PU healing compared to those consuming RDA recommended or less protein intake ($p < .001$).

In addition to protein, calorie intake is important for PU healing. In this study, participants consumed fewer calories per day than recommended. The RDA for calories for male's ranges from 2400-2600 calories per day. The majority of male participants (66%, n=42) consumed well below the recommendation with a mean 1732 calories (SD 450 calories) per day. Most females (69%, n=9) also consumed fewer than the recommended calories of 2000-2400 per day with a mean 1319 calories (SD 399 calories) per day. Only 8% (n=5) of all participants were within RDA guidelines for calorie consumption. The NPUAP recommends intake of 30 kcal/kg per day for persons with PUs or at risk for PU development. Only 9% (n=18) of participants with PUs met the NPUAP guidelines of 30 kcal/kg per day. The mean calorie intake for those participants with PUs not meeting the NPUAP guidelines was 1726 calories (SD 491 calories) per day. Ohura and colleagues (2011) reported that patients who received greater calories had significantly greater reduction in wound surface size and depth.

In our study, we found participants consumed an adequate number of calories from fat (mean 494 calories; SD 290 calories) and an inadequate amount of carbohydrates (mean 939 calories; SD 327 calories). Participants reported carbohydrate intake of 235 grams (SD 82 grams) just slightly lower than the RDA of 325 grams. The mean total fat intake for all participants was 55 grams (SD 32 grams), which is within the recommended range for total fat gram intake of 44 to 78 grams (Zeratsky, 2018). Only 16% (n=12) participants consumed more than 30% of total calories from fats. Among all participants saturated fat intake was above the RDA. The mean daily saturated fat intake was 29 grams (SD 21 grams) with 99% of participants reporting

saturated fat intake above the RDA recommendation of less than 10% of total calorie intake from saturated fats. The mean daily saturated fat intake was nearly double the 13 grams amount recommended for an average 2000-calorie diet by the American Heart (AHA, 2015). Our findings are different from Groah and colleagues (2009), who found both fat and carbohydrate intake were generally high among their study participants. In addition, their study participants consumed a higher amount of daily fats (82 grams) and the same amount of carbohydrates (234 grams) compared with the participants in our study. Consuming increased number of saturated fats, cholesterol, and carbohydrates can lead to chronic diseases such as cardiovascular disease, osteoporosis, obesity, and decrease in wound healing (Tanhoffer et al., 2012; NPUAP 2014). A study by Sabour et al. (2012) found 162 participants with SCI consumed 51% of calories from fat intake, which is nearly double the amount our participants consumed (mean 23% calories from fats). Moussavi et al. (2001) used a 3-day food diary to assess dietary fat intake in 189 participants with SCI. They reported the percentages of calories from total fat intake (85% in men; 75% in women) and saturated fat intake (80% for men; 77% for women) both well above the RDA of less than 30% of total fat and less than 10% of saturated fat from daily caloric intake. Our findings show percentage of calories from total fat intake much lower for both males (22%) and females (28%) and also much lower for percentage of calories from saturated fat (males 27%, females 35%) as compared to Moussavi's study. This difference may be due to changing food habits in the U.S. since the work of Moussavi and associates in 2001. There have been numerous national nutrition agendas focused on healthy eating habits and avoidance of high fat foods (DeSalvo, Olson, & Casavale, 2016). It may be that overall fat intake among the general population decreased during this time and thus may also be reflected in the study participants.

Zinc has been shown to be vital in wound healing by replicating the cells and allowing for growth and protein synthesis (Pierpoint et al., 2014). In our study, women had a zinc intake of 4.3mg/d and men consumed 7.5mg/d, both well below the 8-11mg/d required for men and women (Saghaleini, Dehghan, Shadvar, Sanaie, Mahmoodpoor, & Ostadi, 2018). Participants with a partial thickness PU consumed 4.9mg/d of zinc, well below the RDA. Zinc intake among participants with a full thickness PU was 12mg/d slightly above the RDA. Deficiency in zinc can lead to a loss in appetite, impaired immune function, abnormal taste, and decrease in wound healing (Dorner, Posthauer, Ellen, & Thomas, 2009).

Vitamin D intake among our participants with PUs was 225.2 International Units (IU)/day, seven times greater than the amount of vitamin D consumed by participants without a PU 32.8 IU/d and well below the RDA by the International Osteoporosis Foundation (IOF) of 800 to 1000 IU/d for men and women age 19-70 years old (IOF 2018). Because osteoporosis is a consequence of SCI, a decrease in vitamin D intake can lead to skeletal fragility and can increase the risk for fractures (Dawson-Hughes et al., 2010; Jiang, Jiang, & Dai, 2006; IOM 2005). A decrease in vitamin D levels can contribute to osteomalacia leading to proximal muscle weakness. With muscle weakness there is a decrease in physical function and performance, more likely to break bones, and increase risk for falling (Stockton, Mengersen, Paratz, Kandiah, & Bennell, 2011). In addition, inadequate vitamin D intake has shown to be a contributing factor on the immune system. In a large study by The National Center for Health Statistics from 1988-1994 with 18,883 participants, findings concluded from in home interview and blood samples, participants with low levels of vitamin D had increase in upper respiratory infection (CDC, 1996)

Vitamin C is also important for wound healing and aids with iron absorption (National Institute of Health, 2018). When there is a deficit in vitamin C wound healing may be prolonged, contributing to increased risk for infection by preventing white blood cells from migrating to the wound (National Institute of Health, 2018). Vitamin C intake for female participants was 55.6 mg/d (N=13) well below the RDA of 75 mg/d for women. Male participants vitamin C intake was 86.7 mg/d slightly below the RDA of 90 mg/d, (Saghaleini et al., 2018; National Institute of Health, 2018). A study by Desneves and colleagues (2005) with 16 participants (2 with SCI) with stage 2, 3, or 4 PU were randomly assigned to three diet groups. Group A was given a standard diet, while group B was given a standard diet plus 2 tetrapaks (multinational food pack) containing 72 mg of vitamin C, and group C was given a standard diet plus 2 tetrapaks containing 500 mg of vitamin C. After three weeks, participants consuming diet C with 500 mg of vitamin C demonstrated improvement in PU surface area compared to the other two groups.

Several studies have shown consuming fish and omega 3 fatty acids can decrease Cardio Vascular Disease (CVD) risk (Del Gobbo, Imamura, Aslibekyan, Marklund, Virtanen, Wennberg, et al., 2016; Kris-Etherton, Harris, and Appel 2014; Hu, Bronner, Willett, et al., 2002). In our study, omega 3 fatty acid intake for female participants was 1.37 mg/d which is above the RDA for females (1.1g/d). Male participants consumed.89 mg/d of omega 3 fatty acids which is below the RDA of 1.6g/d for males (National Institute of Health, 2018). Omega 3 fatty acid consumption in our study was similar to the review of omega 3 fatty acid intake and heart failure by study by Djousse and colleagues (2012).

With significant differences in macro and micronutrients intake among participants with and without PUs, surprisingly we did not find a corresponding significant difference in anthropometric measures including body mass index (BMI), and waist circumference. However,

participants without a PU were considered overweight with a BMI 27.05kg/m2 according to the World Health Organization (WHO) standard of less than 24.9 kg/m2. This is consistent with a study by Gupta and White (2006) who studied 408 spinal cord injury (SCI) participants and found 255 SCI participants were overweight with a mean BMI of 28.38 kg/m2. Increases in BMI can lead to coronary heart disease (CHD), ischemic stroke, and type 2 diabetes mellitus (Buchholz & Bugaresti, 2005; WHO, 2018). Due to changes in the composition of the body and physical inactivity, SCI persons are predisposed to metabolic abnormalities increasing the development of CHD (Bauman & Spungen, 2008). In addition, the risk for liver and kidney cancer (Campbell et al., 2016; Chen et al., 2012) can be nearly twice as likely in overweight people as they have a 60% increase risk for gall bladder cancer versus normal weight people (World Cancer Research, 2015; Li et al., 2016; WHO, 2018). BMI underestimates body adiposity in persons with SCI, therefore obesity is a more prevalent problem in this population and warrants attention (Weaver et al., 2007; Jones, Legge, & Goulding, 2003).

Using International Classification of Functioning, Disability, and Health (ICF) theoretical framework for this study provided information regarding the concept Health Condition of PU among participant with SCI. We were able to demonstrate a relationship between variables evaluated under the concept Body Function and Structures. Specifically, we found positive relationships with macro and micronutrients intake and the SIS-SCD scale with the Health Condition PU. We did not find a relationship with anthropometric, disability, or nutrition measurements, and the Health Condition PU. However, we found a relationship with "Who does the cooking" and "Who does the grocery shopping" under the concepts Activity and Participation and the Health Condition PU. We did not find any relationship for "Outside services used" under the concepts Activity and Participation and the Health Condition PU. We

did not find any relationship for the concepts Environmental Factors and Personal Factors as measured in this study and the Health Condition PU. Figure 3:3 presents the theoretical framework identified in this study.

Limitations of the Study

Study limitations included a small convenience sample size, which can influence the power and the ability to detect statistically significant results, and which limits the ability to generalize to the population of persons with an SCI with and without a PU. Because this study used a self-reported food dietary log, it is possible the food log entries may have been underestimated or overestimated. We did not collect detailed data on prescription or over the counter medication use, so we were unable to examine medication use or side effect as they relate to nutrition. In this study, we did not have direct measurement of height and weight and thus relied upon self-reported height and weight, which may not be reliable as it may be underreported in these participants. However, this study did report biometric measures using BMI, triceps skin fold, waist circumference and average mid arm circumference as objective findings that were analyzed to arrive at study conclusions.

A third limitation of the study is that we did not investigate the impact of advancing age on nutritional status. While the mean age of the participants was 47 years, participants ranged in age from 24 to 68 years. Examining age groups with nutritional status may have identified the impact of gerontological factors associated with aging and nutritional intake and metabolism in the older participants. However, these findings provide a foundation for future intervention trials.

Recommendations for Future Research

Future research studies on nutrition and PUs among persons with SCI should include study replication with a larger sample size in other geographic locations in order to generalize results with more confidence within the SCI population. Future studies should document participant's use of prescription and over the counter medication use, herbal supplement or other nutrition supplements.

There is a great need for a thorough investigation of environmental factors, identifying access to healthy options, and documenting grocery stores locations surrounding SCI participant residence in the community. This study was not able to validate dietary intake with laboratory analyses and this is recommended for future work in this area. Although there is a dearth of literature related to SCI and activity, there is limited data related to activity, energy expenditure, and nutrition, this area should be explored for future research. In addition, using a handheld bioelectrical impedance analysis machine to estimate fat levels and a calorimetry to measure energy expenditure in this population is recommended for ease of measurement as well as for increased measurement precision.

Persons with SCI are at risk for obesity and cardiovascular disease, therefore, research should aim at measuring diets that focus on decreasing obesity, which may decrease cardiovascular risk. A recent Cochrane review regarding medical nutrition therapy for persons with PU found the findings in the review were inconclusive, thus demonstrating there is a need for collaboration from doctors and nurse practitioners with registered dieticians to assess the nutritional status of patients with pressures ulcers and develop a nutritional plan to treat deficiencies to meet the current treatment guidelines (Sernekos, 2013; Langer & Fink 2014). Future research is needed with the SCI population to specify BMI classification for obesity. Specific BMI categories for persons with SCI would enable more accurate examination of dietary composition and calorie intake.

Conclusion

This study found significant and clinical differences in micro and macronutrient intake among participants with and without PU indicating persons with SCI are at some nutritional risk. All participants' intake of calories, carbohydrates, zinc, protein, and vitamin D were well below

the Recommended Dietary Guideline for Americans (RDA) putting participants at risk for obesity, PU development, decrease in muscle strength, and possible broken bones with transferring. In addition, saturated fat intake was well above the RDA and American Heart Association (AHA) putting all participants at risk for CVD. Our participants consumed inadequate dietary intake in both quantity and quality. Optimal nutrition is vital in decreasing risk for disability, retaining mental and physical function in an effort to have a better quality of life (Molfino, Gioia, Fanelli, & Muscaritoli, 2014). Current evidence-based guidelines for nutrition care of individuals with SCI and the able body population should include eating a well-balanced, nutritionally complete diet with appropriate calories, protein, micronutrients, and consuming adequate fluids. This was not evident in our participants.

In addition to RDA, our study compared protein and calorie intake results to NPUAP recommended intake for protein and calories and found our participants consumed less than NPUAP recommended protein and caloric consumption. Individuals who are at risk for pressure ulcer development or being treated for a pressure ulcer should be referred to a registered dietitian for assessment and intervention (Keast, Parslow, Houghton, Norton, & Fraser, 2006). Aggressive nutrition support should be implemented for persons with SCI and PUs. In order to address mortality and morbidity within the SCI population periodic screening for carbohydrates and fat abnormalities is recommended with appropriate interventions (Bauman & Sponged, 2001). It is imperative nutritional counseling be improved especially in participants with SCI and PU. Our participants did not consume enough protein and calories. This problem can be addressed today by paying closer attention to more intensive nutritional programs which include regular nutritional observations in order to maximize adherence to healthy diets.

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