THE EFFECTS OF PHYSICAL ACTIVITY, PILATES, STRETCHING AND CORE TRAINING ON LOW BACK PAIN

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by

Heather Ann Kreutz

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THE TREATMENT OF BACK PAIN – PILATES, CORE TRAINING, STRETCHING OR PHYSICAL ACTIVITY

A Thesis

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Abstract

THE EFFECTS OF PHYSICAL ACTIVITY, PILATES, STRETCHING AND CORE TRAINING ON LOW BACK PAIN?

by

Heather Ann Kreutz

Purpose

The purpose of this study was to determine if the number of incidences of low back pain levels were statistically different among individuals participating in pilates, stretching, core training or other types of exercise.

Methods

An Activity Questionnaire was used to determine what factors may be effective in preventing and managing back pain. The activity questionnaire included questions regarding the following: gender, the occurrence and level of low back pain within the last three months, stretching before and after exercise, the length of time muscles are stretched, a variety of activities and the number of days each activity was performed per week, the duration of each exercise session in minutes and the number of weeks of participation in each activity. The activities that were asked about included the following: pilates, yoga, stretching, resistance training, weight training,
zumba, kickboxing class, aerobics, bootcamp, treadmill, bike, stairmaster, elliptical, tennis, swimming, squash, martial arts, core training, step aerobics class, running and walking. Participants filling out the survey were also given the option to list any other physical activities in which they were involved.

Results

Two-hundred questionnaires were made available to individuals at Rio Del Oro, a private, multi-recreational fitness club in Sacramento, CA. Of these 200 questionnaires, 148 were completed and returned in an enclosed folder for review. Out of the 148 questionnaires collected, 128 were deemed appropriate for use in this study. Individuals participating in stretching, other physical activities, pilates and stretching combined, core training and stretching combined and pilates, core training and stretching combined all reported back pain significantly greater than zero and the severity of pain levels found not showing significant differences among the groups.

Conclusions

The results of this study suggest that there is no statistical difference in the levels of low back pain when comparing individuals participating in pilates, stretching, core training and other types of exercise.
Key Words

Exercise, stretching, physical activity, core training, pilates, back pain

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William H. Edwards, Ph.D.

____________________
Date
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Chapter 1

INTRODUCTION

There are many reported areas of injury among individuals participating in physical activity. Areas of injury may include the ankle, knee, hands, wrists, elbows, shins, calves, head, shoulders, neck and clavicle (Adirim & Cheng, 2003).

The results of an injury may include pain and discomfort, time away from work, less motivation to exercise and a decreased amount of time being able of exercise (Hootman et al., 2002). Injuries that occur from exercise or physical activity can also elevate health care costs, and disabilities and reduced mobility can increase the risk of cardiovascular disease and other health problems. Musculoskeletal injuries can also have a significant negative impact on the short-term and long-term activity levels of U.S. adults. In fact, in a recent study, Hootman showed that almost one-third of subjects reported permanently stopping their exercise program after experiencing an injury (Hootman et al., 2002)

There has been a heightened awareness in recent years of back pain and an understanding of the fact that back disorders are extremely prevalent in all societies. In fact, approximately 80% of Americans experience at least one episode of back pain during their lifetime, and 15% to 20% report back pain some time in a 1-year period. (Luo, Pietrobon, & Sun, 2004). In 2001, approximately 5.7 million working days were lost as a result of back pain, which caused a great expense to the economy (Gladwell, Head, & Haggar, 2006). In a recent survey conducted for the United Kingdom, 40% of 5500 people interviewed had experienced back pain within a single year (Gladwell et
al., 2006). In 1998, the direct health care costs of back pain within the United Kingdom, including visits to the general practitioners and referrals to therapists, was estimated to be $1632 million (Gladwell et al., 2006).

When promoting physical activity, the prevention and the rehabilitation of back pain is crucial. Considering the statistics regarding back pain, strategies to prevent and manage back pain need to be better researched and understood (Finch, 2001). Consumers need to have a more balanced view by understanding the risks associated with physical activity and the back pain that can result due to these risks (Koplan, Siscovick, & Goldbaum, 1985). Also, public health practitioners need to be aware of the need to plan and implement prevention strategies due to the potential hazards associated with activity (Hootman et al., 2002). In a recent study, 83% of musculoskeletal injuries were activity related and the highest proportion of all-cause and activity related musculoskeletal injuries among men and women occurred for sports participants (Hootman et al., 2002).

There are many different ways that individuals choose to manage their back pain. A few common ways are via analgesics, surgery, stretching, physical activity, pilates and warming up before a workout. Physical activity, in general, can be effective in preventing back pain, but prolonged, heavy loading can lead to low back pain (Vuori, 2001). Some research shows that many benefits have been found from stretching prior to physical activity (Safran, Garrett, Seaber, Glisson, & Ribbeck, 1988). McHugh and Cosgrave (2010) showed that physiological benefits from stretching include increased blood flow to tissues and an increased speed of muscular
contractions and nerve transmissions, which result in reduced injury and increased flexibility. It has been observed, however, that injury prevention via stretching may depend on the type of activity (Witvrouw, Mahieu, Danneels, & McNair, 2004). Activities involving explosive type skills, for instance, may require more compliancy in the muscle-tendon unit whereas activities such as jogging, walking or cycling may not need the same amount of compliancy. Since stretching increases compliancy, stretching has been recommended for activities using stretch-shortening cycle movements. Other research has also shown that there is no significant correlation between increased flexibility and injuries. For example, Soderman, Derman, Alfredson, and Werner (2001) found that there was no significant correlation between hamstring flexibility and injuries of the lower extremities. Therefore, the effectiveness of pre-exercise stretching on injury prevention and pain management is unclear.

Pilates is commonly used to help prevent injuries and low back pain. Pilates was brought to the United States in 1923 and was used to rehabilitate dancers’ injuries. By the 1990’s, it was being used by many rehabilitation practitioners in fields such as general orthopaedic, geriatric, chronic pain and neurologic rehabilitation (Anderson & Spector, 2005). There are many claimed benefits as a result of performing pilates, including greater strength, flexibility and proprioception, improved functional activity in multiple planes of movement, a stronger core, more efficient movement of the extremities, improved body alignment and posture (Bryan, 2003). Research has also shown that pilates may reduce the amount of pain in individuals with non-specific low back pain (Lim, Poh, Low, & Wong, 2011).
Despite the fact that pilates is used in rehabilitation settings and by a number of health care professionals to help treat back pain, it still remains unclear whether or not pain management and injury prevention are due to the specific nature of pilates exercises and there is still a lack of supportive literature examining this phenomena. (Anderson, 2005).

**Purpose of Study**

The purpose of this study was to determine if the number of incidences of low back pain were statistically different between individuals participating in pilates, stretching, core training or other types of exercise.

**Research Questions**

For the purposes of this study, the following questions were posed:

1. Is the incidence of back pain and the level of back pain reduced for individuals participating in pilates regularly compared to other types of classes exercising the core?

2. Is the incidence of back pain and the level of back pain reduced for individuals participating in pilates regularly compared to other types of exercises?

3. Is the incidence of back pain and the level of back pain reduced for individuals participating in core training regularly, compared to other types of exercise?

4. Is the incidence of back pain and the level of back pain reduced for individuals participating in core training regularly, compared to other types of exercise?

5. Is the incidence of back pain and the level of back pain reduced for individuals participating in pilates regularly compared to other group exercise classes?
6. Is the incidence of back pain and the level of back pain reduced for individuals that stretch regularly?

**Hypothesis**

The incidence of back pain and the level of back pain will be shown to be less for individuals participating in pilates, core training and stretching regularly compared to other activities.

**Significance of Study**

There have been many studies that have assessed the effects of stretching, pilates and physical activity on the prevention and management of back pain. However, with conflicting results, there is still no clear understanding of whether pilates, stretching and physical activity effectively manage and prevent back pain. From the results of this study, a better understanding of how to manage back pain can be provided.

**Assumptions**

1. Participants will answer questions on the survey truthfully
2. Participants will interpret questions on the survey accurately

**Limitations**

1. Some answers on the survey may be exaggerated. For example, some individuals may mark a higher level of back pain than what is actually experienced, or some individuals may check yes to stretching though not holding the stretch longer than a few seconds each time.
Delimitations

1. Additional questions that could be useful on the survey were not included, such as: “Have you been provided with a diagnosis by a doctor or physical therapist?”, “Have you ever had extensive training on how to correctly perform pilates exercises”, “Have you ever had extensive training on how to stretch correctly? If so, explain.”

2. Low back pain discussed in this thesis is limited to pain that has occurred only in the last three months.

3. Activities discussed in this thesis are limited to the activities listed on the survey.

4. Information gathered about the activities discussed in this thesis is limited to the numbers of day per week; the duration in minutes; the intensity with 1 being easy, 2 being moderate and 3 being hard and the number of weeks of participation.

5. Other factors not discussed in this thesis may contribute to back pain.

Definition of Terms

Anterior cruciate ligament (ACL): a ligament in the knee that crosses from the underside of the femur (the thigh bone) to the top of the tibia (the bigger bone in the lower leg).

Core Training: any and all abdominal exercises that affect the abdominal muscles.
Hamstring: any of the three muscles constituting the back of the upper leg that serve to flex the knee joint, adduct the leg, and extend the thigh.

Low back pain (LBP): a dull, continuous pain with tenderness near the muscular attachment sites of the lower lumbar, lumbosacral, and sacroiliac vertebral segments.

Martial arts: extensive systems of codified practices and traditions of combat, practiced for a variety of reasons, including self defense, competition, physical health and fitness, as well as mental and spiritual development.

Mobilization: the restoration of mobility to affected joints and muscles.

Musculoskeletal: relating to muscles and skeleton

Musculotendinous: relating to, or affecting muscular and tendinous tissue.

Non-specific low back pain: a condition where there is localized pain in the back but no specified origin found.

Pilates: a method of physical and mental exercise involving stretches and breathing that focus on strengthening the abdominal core. Pilates is a physical fitness system developed in the early 20th century by Joseph Pilates.

Rotator cuff: a group of four muscles that stabilize the shoulder joint.

Stretch-shortening cycle (SSC): an active stretch (eccentric contraction) of a muscle followed by an immediate shortening (concentric contraction) of that same muscle.

Visual Analogue Scale (VAS): visual scale used to record pain levels.
Chapter 2

REVIEW OF LITERATURE

The purpose of this study was to identify what exercise factors may be effective in reducing the severity and number of incidences of back pain. Therefore, this chapter will review the conflicting research that exists regarding the following relationships: (a) stretching and its effect on the number of back pain incidences and the level of severity of back pain, (b) pilates and core training and their effect on the number of back pain incidences and the level of severity of back pain, and (c) physical activity and its effect on the number of back pain incidences and the level of severity of back pain. This chapter will also discuss the studies that show a positive correlation between pilates and low back pain; however, it is important to understand that there is minimal research that has been done in this area.

Stretching and Injury Prevention

Stretching is one injury prevention strategy that is found in the literature; however, contradictions on stretching as a preventative strategy do exist within the literature. For example, in a recent study, stretching failed to show any positive effect on individual injury risk (Coppack, Etherington, & Wills, 2011). Another study found that systematic stretching enhanced the functional gains of patients with chronic low back pain (Khalil, Asfour, & Martinez, 1992).

Articles supporting the concept of stretching being beneficial to pain management and injury prevention include Moffett, Torgerson, and Bell-Syer (1999); Woods, Bishop, and Jones (2007); and Shehab, Mirabelli, and Gorenflo (2006).
Moffett et al.’s (1999) study included 187 patients aged 18-60 with mechanical low back pain of 4 weeks to 6 months duration. The intervention group that incorporated stretching reported less distressing pain after the study, and one year later showed a significantly greater improvement in the Aberdeen Back Pain Scale and reported only 378 days off from work compared with 607 in the control group. The intervention group, however, also incorporated strengthening exercises, relaxation sessions and education on back care. These other variables could be viewed as a weakness in this study and may not provide enough support to say that stretching was, in fact, the reason for the improvement due to stretching not being an isolated intervention.

Woods (2007) examined the potential of a warm-up and/or stretching routine in deterring muscular injury during physical activity. This study provides contradictory evidence to conclusions drawn in previous review articles, which determined that increased flexibility does not deter injury (Soderman, Derman, Alfredson and Werner, 2001). Research in this article conveyed that certain techniques and protocols have shown a positive outcome on deterring injuries and that a warm-up and stretching protocol should be implemented prior to physical activity.

Shehab et al.’s (2006) study assessed the knowledge, attitudes and practices of high school coaches regarding pre-exercise stretching. A cross-sectional survey was distributed at multiple high schools. Seventy-one head coaches at 10 county high schools completed the survey. The results showed that almost 95% of the coaches felt that stretching was beneficial, especially in decreasing injury risk. Nearly 73% of the
coaches believed that there were no drawbacks to stretching. Shehab et al. concluded that coaches believe that pre-exercise stretching prevents a wide array of injuries.

There have been many studies suggesting that stretching before exercise is not beneficial. According to Shrier (2000), these studies should be weighted as stronger because they consist of a more appropriate analysis. Shrier has also provided explanations for why he believes stretching has not been found to be beneficial in injury prevention. Shrier states that most injuries are believed to occur during eccentric contractions, which can cause damage during the normal range of motion. Since many injuries occur in the normal range of motion, it does not make sense to increase range of motion in order to prevent injury. Shrier’s second reason is that since stretching has an analgesic effect and can increase one’s tolerance to pain as well as cause damage at the cytoskeletal level, stretching promotes the problem of exercising a damaged anaesthetized muscle, which can increase the risk of injury. Shrier also disagrees with the idea that a compliant muscle is less likely to be injured. Shrier states that basic research shows that an increased compliancy in a muscle results in a decreased ability to absorb energy. Shrier argues that research does not show that increased compliancy results in a greater ability to absorb energy.

Other research has shown that an acute bout of stretching has no effect on injury prevention and that stretching may be attributed to injury. The skeletal muscle and the muscle spindle can change their mechanical tension after a stretch, causing proprioception to be altered and a decreased stiffness and tension in the muscle, therefore resulting in increased compliance and reduced spindle activity, which may
attribute to injury (Bjorklund, Djupsjöbacka, & Crenshaw, 2006). Bjorklund et al. found that an acute bout of stretching had no effect on shoulder position sense, a sub-modality of proprioception. Jamtvedt, Herbert, and Flottorp (2010) showed that significant reductions in all-injury risk were not due to stretching. Anderson (2005) reviewed articles including studies involving stretching that occurred immediately before or after exercise and found the results were not statistically significant in favor of either stretching or not stretching and concluded that the stretching protocols used in the studies reviewed did not meaningfully reduce lower extremity injury risk of army recruits undergoing military training.

Stretching is usually practiced as a component of a general warm-up. Some intended purposes for stretching prior to exercise are to ensure that the individual has sufficient range of motion in his or her joints to perform an exercise optimally and to decrease muscle stiffness or increase muscle compliance for the purpose of decreasing the risk of injury. Epidemiological studies have shown, however, that pre-participation stretching in addition to a warm-up will have no impact on injury risk during activities where there is preponderance of overuse injuries (Mchugh & Cosgrave, 2010).

**Pilates and Pain/Injury Management**

Within the last two decades, there has been a significant increase in the popularity of exercises based on Pilates' teachings. In the USA alone, more than 700 studio and rehabilitation sites use Pilates methods (Larkam & Brownstein 1998). Pilates has become a world-wide exercise modality due to its wide array of benefits including improved strength, mobility, endurance, flexibility, proprioception, core
stability, body control, and because of its mind-body effects. Pilates has also been proposed as a method of rehabilitation and training. In fact, physical therapists all over the world are becoming much more familiar with pilates techniques and are incorporating them into their practice (Merrithew, 2009). It has been stated that pilates can improve pain level and sports functioning in individuals with chronic low back pain (Gladwell et al., 2006). It has also been stated that pilates can help prevent injuries. For example, Cassie Campbell, a Canadian women’s hockey icon, stated that “Many professional hockey players are taking the pilates plunge to help prevent injuries specific to their sport (Merrithew, 2009).

Pilates is known to be a very powerful pain reduction technique. According to Merrithew (2009), a combination of the steps applied in pilates, including redirecting a client’s focus mentally and physically, oxygenating the blood, increasing blood flow and building strength, feeds into how well an individually successfully manages chronic pain and pain in general. Additionally, pilates teaches an individual how to breathe effectively, which in turn is a pain reduction technique and the breathing pattern used in pilates delivers more oxygen to the areas of pain and reduces tension in muscles. Chronic pain can also be caused by a coexistence of structural or functional mal-alignment with muscle weakness, inefficiency and overuse which can be corrected by a supervised, regular pilates program. By simply deactivating an overused muscle, a significant step towards pain reduction can be achieved. (Merrithew, 2009).
Joints can often become overused through repetitive movements and high demand training (Merrithew, 2011). The key to controlling joint movements and sustaining the stability of the joints is to focus on the deeper muscle groups of the body. Pilates focuses on these deeper muscle groups. Certain muscles typically get overused regardless of the type of sport or exercise and cheating patterns or compensatory patterns can develop to perform specific skills and movements. A few benefits to pilates are the proper stability and movements that can be gained in the joints, which can result in movements that are more biomechanically efficient. For example, pilates can help increase hip stability and can strengthen the deep abdominal muscles and upper midback, which are all essential to improving a golfer’s performance (Merrithew, 2011). With a strengthened core, a golfer is more correctly and efficiently set up to the ball with less pain. Many national golf schools and coaches are now implementing pilates classes into their programs (Merrithew, 2011).

Pilates techniques aim to specifically train the “core muscles” submaximally to increase the tone and strength of these muscles, to lengthen and stretch the lumbar spine thus decreasing compression of the joints, and cause an alteration in the tilt of the pelvis. Pilates also helps strengthen and find stability in all planes of motion and aims to create balance throughout the entire body (Merrithew, 2011). Pilates-evolved work is built on the foundation of achieving efficient movement and returning to functional movement. The desired outcome for functional movement is trunk control. It can, therefore, be said that treatment can occur from Core Stiffening, which is at the root of pilates-based work and has been shown to facilitate controlled movement.
(Anderson & Spector, 2005). It is hypothesized that the Transversus Abdominis, identified as the primary postural control muscle, provides trunk stiffness during dynamic movements. Findings also support the use of independent transversus abdominis contractions being effective for the treatment of low back pain (Herrington & Davies, 2005). And, since Pilates-based exercise incorporates the strengthening of the Transversus Abdominus, it is believed that Pilates can help treat chronic low back pain.

Pilates uses specific core stability exercises incorporating functional movements which were shown by Gladwell et al. (2006) to improve non-specific chronic low back pain in an active population compared to no intervention. Pilates subjects showed improvement in pain level and disability outcomes (Anderson, 2005). Similarly, pain levels also improved in a pilates group studied by Gagnon (2005). In another study, Hawson (2002) reported that four out of five pilates subjects reported a decrease in pain level. Rydeard, Leger, and Smith (2006) showed that low back pain and functional disability levels were reduced significantly from pilates exercise in comparison to usual care. Hawson’s subjects, whom had chronic low back pain for at least three months, participated in a physical therapy program that utilized pilates exercises. The results showed improvement in pain intensity and functional disability scores in the majority of the subjects. In Rydeard et al.’s study, 39 physically active subjects with chronic low back pain between the ages of 20 and 55 years old were assigned randomly to one of two groups. One group did pilates for four weeks while the other group received usual care with a physician and other health-care
professionals, as necessary. Pilates sessions consisted of activating specific muscles thought to stabilize the lumbo-pelvic region. Results were determined via the Roland Morris Disability Questionnaire and the mean for the scores for pain intensity in the pilates group was 18.3 compared to 33.9 in the control group that received usual care. The functional disability and average pain intensity were significantly lower in the exercising group compared to the control group. The pilates group maintained an improvement in low back pain for 12 months following the study.

Additionally, a systematic review of randomized controlled trials comparing the effect of pilates-based exercises with other forms of interventions on pain and disability in individuals with persistent nonspecific low back pain was reported by Lim et al. (2011). This meta-analysis provided useful information about the magnitude of the effect of pilates-based exercises on pain and disability. Although the search on the electronic database resulted in 211 articles, only 18 were selected for detailed review and only 7 were eligible for inclusion in the final analysis. Additional and helpful articles found from this meta-analysis included the studies mentioned above, as well as Donzelli, Di Domenica, and Cova (2006), O’Brien, Hanlon, and Meldrum (2006), and Quinn (2005).

Donzelli et al. (2006) recruited 53 patients with at least three months of nonspecific, low back pain. Each participant entered into pilates therapy or Back School. Back school usually involves interventions where patients are taught about the anatomy and function of the back and mechanical strain and posture, and where isometric exercises for abdominal muscles and physical activity programs may also be
given. Forty-three participants completed the study, and small exercise groups of seven patients each followed a daily kinesitherapy protocol for 10 days. Evaluations were performed at the start of the study and then at one, three and six months after the beginning of treatment. The Oswestry Low Back Pain Disability Scale (OLBPDQ) and the visual analog scale (VAS) were used to evaluate pain and the level of disability. A significant reduction in pain intensity and disability was observed across the entire sample, and the Pilates method group showed better compliance and subjective response to treatment. The results obtained with the Pilates method were also found to be comparable to those achieved with the Back School method, suggesting its use as an alternative approach to the treatment of non specific low back pain.

O’Brien et al. (2006) recruited seven males and two females with an average age of 33.8 years, from Medical General Practitioner Clinics. Intervention included eight pilates sessions, lasting one hour per session, over a four to six week period. O’Brien compared the pilates group to a control group and a group consisting of only standard physiotherapy. A significant difference between the treated groups and the control groups was found, however, no significant difference was shown between the pilates and the standard physiotherapy group.

Quinn (2005) recruited subjects from local commercial and community fitness centers. Subjects had an average age of 46.3 and gender was not considered. Intervention consisted of 24 pilates-based mat sessions, 45-60 minutes each, over a 12 week period. A control group was also used as a comparison. The results showed a
significant decrease on the Oswestry Disability Questionnaire (ODQ) for the pilates based mat exercise group from preintervention to postintervention, although, pilates exercises were shown to be no more effective than other exercise interventions. Lim et al. (2011) also concluded from their meta-analysis that pilates based exercises are superior to minimal intervention for reduction of pain in individuals with non-specific low back pain.

Another study also concluded that the addition of Pilates therapy can be useful to care for patients with chronic low back pain and deconditioning (Blum, 1999). The objective of this study was to describe the use of pilates therapy in the management of a 39 year old woman with scoliosis who had progressive severe low back pain that had worsened over the years after surgery. The pain had prevented her from activities such as carrying her son or equipment necessary for her job as a photographer. Intervention included a series of pilates exercises. The results showed that this patient became unlimited in her physical activity, although some symptoms of scoliosis were still exhibited (Blum, 1999) These data tend to suggest that pilates is effective in attenuating pain, particularly for the low back (Lim et al., 2011).

**Recommendations for Managing Chronic LBP**

Contradictions to some of the benefits of pilates being effective for the management of low back pain are found in the literature, and despite the popularity of the pilates method, this mode of exercise has little research to support its benefits. Shedden and Kravitz (2006) claim that in the published peer-reviewed research that does exist, research lacks adequate controls of the training interventions, shows low
reliability of the instruments used to measure strength and flexibility, uses improper statistical analysis and lacks statistical power. For example, one study looked at the effects of pilates training on flexibility and body composition (Shedden & Kravitz, 2006). In this study, the subjects participated in one pilates mat class that lasted for one hour every week for six months. The results showed no changes in body composition, posture or health status. Shedden and Kravitz concluded that one hour per week would not be enough to induce significant change, a greater training volume would be necessary to build more muscle mass, that the postural measurement was poorly evaluated due to asking the subjects to stand up straight rather than to stand with their normal posture and that this study’s health questionnaire was not specific enough to detect health change (Shedden & Kravitz, 2006).

A claimed benefit to pilates is greater mobilization of the back and a common recommendation is to increase back flexibility to prevent episodes of low back pain. Some reports in the literature, however, do not support this fact. In fact, Mcgill (2003) suggested that a more flexible back is more prone to injury. Mcgill’s recommendation for a better predictor of low back health is greater endurance of the low back muscles.

Coordination and mobilization, which are some of the claimed direct benefits gained from pilates, have been shown to be the least effective methods for improving low back pain and function compared to stretching, aerobic exercise, strengthening exercises and stabilizing exercises. According to Muir (2008), stretching has been found to provide small improvements in pain whereas strengthening exercises have been found to be more effective for improving function. High intensity exercise
programs (more than 20 hours per week) are more effective than lower intensity exercise programs, supervised programs are more effective than non-supervised programs and individually designed programs have been found to be more effective than group exercise. Liddle, Baxter, and Gracey (2004) also concluded in their study that better long term results were displayed from a supervised exercise group than with the group performing exercises at home with no feedback. The purpose of Liddle et al.’s study was to investigate the current evidence for the type and quality of exercise being offered to chronic low back pain patients (CLBP) and to assess how treatment outcomes are being measured. Liddle et al. claim that fully or partially supervised programs might contribute to the maintenance of the exercise benefits with CLBP patients.

Stretching and strengthening types of exercises, which are incorporated into Pilates programs, have not been found to be any more effective at treating back pain than other forms of exercise (Muir, 2008). In a systematic review of training programs not including pilates exercises but incorporating strength and balance exercises, an injury risk reduction greater than 50% was reported in five out of the six studies reviewed (Coppack et al., 2011). Strengthening exercises were also found to be helpful in Liddle et al.’s (2004) study. In 12 out of 16 trials, strengthening was the predominant exercise, with the targeted sites of strengthening being the lumbar spine and lower limbs. Rainville et al. (1997) had the same conclusions in his study, which primarily highlighted the importance of strengthening the lumbar spine to facilitate trunk stabilization (Liddle et al., 2004).
Conclusion

Unfortunately, research shows a lack of evidence for treatments for patients with Non-specific chronic low back pain (NSCLB). And, scientific evidence to support the effects of stretching is also lacking (Coppack et al., 2011). Further investigation needs to be done to better determine what factors might contribute to improving low back pain and, consequently, the quality of people’s lives who struggle with it.
Chapter 3

METHODOLOGY

The purpose of this investigation was to determine if the incidences of low back pain were statistically different among individuals participating in pilates, stretching, core training and other types of exercise. The procedures that were used in this investigation are discussed in this chapter.

Subjects

In March of 2012, an activity questionnaire was administered to individuals at the Rio del Oro Racquet Club, a multi-recreational fitness club in Sacramento, California, that includes pools for swimming, tennis and racquet courts, various fitness classes, a weight room, a room with cardiovascular equipment, as well as personal training, child care and massage therapy. The Rio Del Oro demographic is comprised primarily of educated, upper-middle class, middle-aged individuals who are generally health conscious and physically active and live in one of the higher profile areas of the greater Sacramento region. Individuals with memberships also pay $100 per month to attend Rio Del Oro. The questionnaire was administered to individuals before and after group exercise classes. Sixty-one classes are held per week with an average of eight people per class; therefore the estimated pool of participants was 488. Participation in this study consisted of receiving a consent form, answering all of the questions on the activity questionnaire and submitting the questionnaire with an anonymous identification. Males and females both were able to participate in this
study, and it was assumed that the majority of the individuals filling out the survey would be members of the Rio Del Oro Racquet Club.

**Research Design**

An Activity Questionnaire was used to determine what factors may be effective in preventing and managing back pain. The activity questionnaire was developed with the purpose of determining what activities showed correlations with a lower number of incidences of back pain and lower levels of back pain experienced. One benefit to including activities other than pilates and stretching on the questionnaire was to provide this study with a comparison. This comparison showed whether or not individuals participating in pilates and stretching showed a significant difference in low back pain compared to individuals participating in activities different from pilates and stretching. The activity questionnaire included questions regarding the following: gender, the occurrence of and level of low back pain within the last three months, stretching before and after exercise, the length of time muscles are stretched, a variety of activities and the number of days each activity was performed per week, the duration of each exercise session in minutes and the number of weeks of participation in each activity. The activities that were asked about on the survey included the following: pilates, yoga, stretching, resistance training, weight training, zumba class, kickboxing class, aerobics class, bootcamp class, treadmill, bike, stairmaster, elliptical, tennis, swimming, squash, martial arts, core training, step aerobics class, running and walking. Participants filling out the survey were also given
the option to list any other physical activities in which they were involved. A copy of the questionnaire is included in Appendix A.

**Procedures**

The questionnaires, with the consent forms attached, were administered to individuals at the Rio Del Oro Racquet Club in March of 2012. Conversations with participants were kept to a minimum with the exception of answering questions that participants had about how to fill out the survey. The purpose for the survey and the thesis topic were not held back from the participants and were included on the consent form. Before and after group exercise classes, the instructor announced the purpose of the questionnaires and made them available to participants. Questionnaires were also available in a box just outside of the group exercise room with a flier posted to the box explaining the purpose of the questionnaires.

**Statistical Analysis**

The results from this study were determined by using ANOVAs. The probability of the results being accurate were less than .05, resulting in a confidence level of 95%.
Chapter 4

RESULTS

Data Collection

The purpose of this study was to determine if the number of incidences of low back pain were statistically different between individuals participating in pilates, stretching, core training and other types of exercise. For the purpose of this study, 200 questionnaires were made available to individuals at Rio Del Oro, a multi-recreational fitness club in Sacramento, CA. Of those 200 questionnaires, 148 were completed and returned in an enclosed folder for review. Of the 148 questionnaires collected, only 128 were used in this study due to 20 of the informed consent forms attached to each questionnaire not being signed by the individual. After examination, the data were grouped by activity as follows: pilates only, core training only, stretching only, other activities, pilates and core training combined, pilates and stretching combined, core training and stretching and the combination of pilates, core training and stretching.

Clean and Screen

Outliers were scanned for in this study. An outlier was defined as a pain score that was more than two standard deviations from the group mean. After reviewing all questionnaires, it was determined that no one had pain scores greater than or less than two standard deviations from the mean and therefore no questionnaires had to be removed from the analysis for this reason.

An average, a standard deviation, the sum and the range of pain levels were determined for each group. It was determined that sample sizes of ten or less in an
activity group would be removed from the analysis. This decision resulted in the removal of the group of individuals only participating in pilates and the group of individuals only participating in core training. The pilates only group had a sample size of six participants and the core training only group had a sample size of three participants (see Table 1). The group that also participated in both pilates and core training was also removed since there was only one participant in that group. The groups of individuals that were then examined further were as follows: (a) stretching only, (b) other activities, (c) pilates and stretching combined, (d) core training and stretching combined, and (g) the combination of pilates, core training and stretching.

Data were then entered into Excel by activity group. Table 1 shows the mean, standard deviation and sum for each group.

Table 1

*The Mean, Standard Deviation, and Sum for Each Group*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Sum (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilates</td>
<td>1.67</td>
<td>2.66</td>
<td>6</td>
</tr>
<tr>
<td>Stretching</td>
<td>1.91</td>
<td>2.164</td>
<td>39</td>
</tr>
<tr>
<td>Core Training</td>
<td>2</td>
<td>3.5</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>1.86</td>
<td>2.53</td>
<td>32</td>
</tr>
<tr>
<td>Pilates and Stretching</td>
<td>2.28</td>
<td>2.67</td>
<td>14</td>
</tr>
<tr>
<td>Core Training and Stretching</td>
<td>2</td>
<td>2.72</td>
<td>18</td>
</tr>
<tr>
<td>Pilates, Core Training and Stretching</td>
<td>1.625</td>
<td>1.927</td>
<td>16</td>
</tr>
<tr>
<td>All Groups combined</td>
<td>1.906</td>
<td>2.37</td>
<td>128</td>
</tr>
</tbody>
</table>
Severity of Pain

The average results for all of the groups combined, including the examination of 119 questionnaires, were the following: mean: 1.915, standard deviation: 2.36, n=:119, 95% confidence interval: 1.50-2.34. All groups showed to have back pain significantly greater than zero. All of the 95% confidence intervals overlapped each other, signifying that the severity of the pain levels found was not different between the groups. Figure 1 illustrates the 95% confidence intervals of pain levels, showing the lack of statistical significance between groups. The number range for the 95% confidence intervals are shown in Table 2.

Figure 1. Comparison of the Range of Possible Pain Levels for Each Group.
For each category, pain levels represent the average ± the 95% confidence interval. Each range of pain levels represents the average ± the standard deviations for each category.

Table 2

95% Confidence Intervals for Each Group and Each Activity

<table>
<thead>
<tr>
<th>Category</th>
<th>Lowest</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stretching Only</td>
<td>1.23</td>
<td>2.59</td>
</tr>
<tr>
<td>Other</td>
<td>.98</td>
<td>2.74</td>
</tr>
<tr>
<td>Pilates and Stretching</td>
<td>.89</td>
<td>3.69</td>
</tr>
<tr>
<td>Core Training and Stretching</td>
<td>.74</td>
<td>3.26</td>
</tr>
<tr>
<td>Pilates, Core Training and Stretching</td>
<td>.69</td>
<td>2.57</td>
</tr>
<tr>
<td>Group</td>
<td>1.50</td>
<td>2.34</td>
</tr>
</tbody>
</table>

Incidence of Pain

The data collected from the completed and submitted questionnaires in this study showed a high incidence of back pain among all groups of individuals, with the exception of the pilates only and core training only group. The data for these groups was not used due to the low sample size for each group. The Pilates only group had a total of six participants and the core training only group only had a total of three participants. Of the 119 individual questionnaires analyzed, 56 individuals marked that they had mild to severe back pain, which included 47% of all participants. The percentages of back pain found in each group were as follows: Stretching only: 48%; Other Types of Exercise: 40%; Pilates and Stretching: 50%; Core Training and
Stretching: 44%; Pilates, Core Training and Stretching: 56%. This data demonstrates that the incidences of back pain are significant for individuals participating in all of the groups analyzed in this study. The percentages of people having pain for each group is shown in Figure 2.

Figure 2. Comparison of the Pain Represented as the Percentages of People Having Pain for Each Group.
Chapter 5
DISCUSSION

Numerous studies have been conducted on the treatments for low back pain. However, the results of those studies have been equivocal. The purpose of this investigation was to examine common forms of exercise, including pilates, on the severity of back pain. The primary focus of this study was to analyze the incidence of low back pain and the levels of back pain among groups of individuals participating in the following activities: pilates only, pilates and core training, pilates and stretching, core training only, core training and stretching and pilates, core training and stretching.

Questionnaire Interpretation

Levels of back pain are easily interpreted by individuals using the VAS. There is, however, always a chance that the VAS levels of low back pain marked on the questionnaires were exaggerated, leading to higher confidence intervals than what would normally have been observed.

Participants in this study may have also not understood the difference between core training and pilates. These two activities are, in fact, different, though some participants may have not been educated on the differences between the two. Some individuals may have marked only core training when they actually only perform pilates, and other individuals may have also marked pilates when they actually only perform core training.
Pilates and Back Pain

Many studies (e.g. Gagnon, 2005; Gladwell, et al., 2006; Hawson, 2002; Rydeard et al., 2006) have been conducted to determine if pilates promoted an improvement in back pain levels. Those data suggest that pilates is effective in attenuating pain, particularly pain for the lower back. Many of those studies involved intervention, whereas the present study did not involve intervention. All of these studies showed that back pain improved after an intervened program of regular pilates exercises. The intervention incorporated into these studies may provide one explanation as to why pilates was shown to be successful at improving back pain. Incorporating intervention into a pilates study can result in many different benefits. Educating the subjects on how to perform the exercises correctly and supervising the subjects to be sure they are completing the exercises with reasonable effort and at a sufficient level that can result in positive outcomes are some ways intervention may have been an advantage in these studies. Other ways intervention may have been helpful included correcting the subjects if an exercise was done incorrectly and offering a more diverse option for exercises by incorporating special pilates apparatus into the pilates sessions due to a certified pilates trainer being present. Due to the lack of intervention in the present study, the results may have been skewed and may provide one explanation as to why no difference in the severity of back pain was shown for the participants incorporating pilates into their workout regimen.

Among all of the benefits that may be attained from incorporating intervention, one disadvantage to intervention can be the lower number of subjects typically
participating in these types of studies. The distribution of questionnaires in this study had an advantage due to the larger sample size attained compared to the studies mentioned above. There were 119 questionnaires reviewed to determine the results in this study, whereas in Gagnon’s study (2005) there were only 12 subjects; and in Hawson’s study (2002) there were only five subjects. Additionally, Rydeard et al.’s study (2006) only included 39 subjects and Gladwell et al.’s study (2006) included 49 subjects. Gladwell et al.’s study did have a significantly larger sample size; however, in their study, Pilates was applied as an additional intervention to current drug treatments of the subjects, which included analgesics. This was a disadvantage in her study because pilates exercises were not isolated as the only potential reason for the results attained. Nonsteroidal anti-inflammatory drugs could have been the reason for the improved back pain levels reported by the subjects, instead of the pilates exercises.

In this study, reviewing the severity of back pain for individual’s participating in pilates only was not an option since the pilates only group having only six participants. This was unfortunate because if the sample size in the pilates only group was larger, it is possible that the pilates only group would have had a greater chance of showing a statistically lower severity of back pain than the other groups. These data, however, were able to determine the effects of pilates incorporated into workout regimens that included other activities. Findings of the present study showed that in the groups where pilates was one of the activities of participation, the severity of back pain was no different from groups where pilates was not an activity in the regimen. This may have been due to the fact that pilates was not an isolated exercise for these
individuals. The other activities incorporated along with pilates may have had an influence on the benefits of pilates and may have skewed the results.

The severity of back pain may have also not been different among the groups incorporating pilates as a part of their workout regimen because many of the participants reported that they had chronic back pain. One explanation for Gagnon’s (2005) study showing pilates to be effective in improving back pain may have been due to having fewer subjects with chronic back instead of acute back pain. Only 66.7% of participants in Gagnon’s study had chronic back pain, whereas in our study, 79% of the participants that reported back pain had chronic back pain, defined as pain existing for longer than 3 months. Only 21% of the participants reported acute back pain in the present study. According to Waddell (1987), chronic pain is a different clinical syndrome from acute pain. Pharmacological, physical and even surgical treatments are generally highly effective in relieving acute pain whereas chronic pain is a progressive, self-sustaining condition that is resistant to traditional medical management. Physical treatment for chronic back pain has been found to be understandably unsuccessful and may even cause additional physical damage, reinforce and aggravate the pain, distress, disability and illness behavior (Waddell, 1987). In fact, a cross-sectional study has indicated that the cause for back pain may be due to non-musculoskeletal problems (Anderson, 1999). This study found an association between psychological factors and the occurrence of low back pain. Psychological factors that may contribute to the cause of low back pain include anxiety, depression, stressful responsibility, job dissatisfaction, mental stress at work,
negative body image and poor drive satisfaction. Considering the non-musculoskeletal causes that may contribute to chronic low back pain, this may provide an explanation as to why the pilates exercises in certain groups in the present study did not show a difference in back pain severity levels. Pilates is known to help low back pain by improving musculoskeletal dysfunction, but if musculoskeletal dysfunction is not the cause of the back pain, then this could be one explanation for the present results. In future studies, a greater understanding of the cause of the back pain being reviewed would be an important consideration.

Reasons for the results showing no back pain severity differences in the groups incorporating pilates exercises may also have been due to a number of additional reasons. These include participants already having existing back pain, pilates participants having greater body awareness, participants performing pilates exercises incorrectly and other factors unknown.

The pilates and stretching group, for example, may have had the highest severity of back pain because individuals with a greater severity of back pain may have been encouraged to participate in pilates in order to try to improve back pain that already existed. Since 79% of the participants in this study had chronic back pain, there is reason to believe that the already existing progressive back pain is what led these individuals to start incorporating pilates exercises into their regimen.

Individuals participating in pilates in the pilates and stretching group may have also been more in tuned with their bodies and may have had the tendency to have greater body awareness, resulting in a greater sensitivity to pain. This is a reasonable
assumption considering a greater awareness of one’s body is a benefit to performing pilates regularly (Glosten, 2009).

Incorrectly performing pilates exercises could have also occurred due to a lack of supervision. Some participants may have checked pilates as an activity performed on their own without the supervision of a certified pilates trainer or an instructor. Without supervision by a certified pilates instructor, these participants may have lacked the appropriate level of education and correction needed to perform the pilates exercises correctly. Even if these participants regularly performed pilates exercises in a pilates class, sometimes the number of participants in the class can make it hard for the instructor to effectively supervise each individual. The pilates classes at Rio Del Oro can include up to 10-15 participants. This number of participants would make it nearly impossible for accurate supervision to be given to each individual during every exercise. Considering the large class sizes found at Rio Del Oro, it is also possible that if this study was done in a different gym or pilates studio with smaller class sizes, the results could have shown groups including pilates exercises in their regimen to have different back pain severity levels compared to the other groups.

Pilates exercises are unique because they consist of activating specific muscles thought to stabilize the lumbo-pelvic region and they use specific core stability exercises incorporating functional movements which were shown by Gladwell et al. (2006) to improve non-specific chronic low back pain in an active population compared to no intervention. Pilates has also been shown to help improve stability and movements that can be gained in the joints, which have resulted in movements that are
more biomechanically efficient. These benefits, along with many others that are attained from pilates, may not effectively cure or improve back pain, however, and more research needs to be done to show whether or not effects of pilates truly prevent and manage back pain effectively.

**Stretching and Back Pain**

Based upon the results of the present study, stretching is a common activity performed by individuals; sixty-seven percent of the participants marked stretching as an activity regularly performed in this study. This percentage was higher when compared to the level of participation in the other groups in this study; however, the stretching group showed no difference in the severity of back pain. In fact, the stretching group had a high percentage of incidences of back pain with almost half of the participants in this group still experiencing back pain. This study showed that the severity of back pain is no different with stretching than with regular physical activity.

Many people still believe that stretching is an effective strategy to improving back pain, whereas this study shows contradiction to the common belief regarding this topic. Physical education classes, articles, news reports and word of mouth have, for many years, all contributed to the idea that stretching is a good activity for people to participate in for many years. People are constantly being told that stretching can produce positive results. More specifically, many individuals are taught that the more flexibility one attains, the more “in shape” they are. A further lesson learned from society is that when you feel pain, stretching is the answer to improving that pain. Reputable magazines and websites also discuss the benefits of stretching on pain
levels. For example, spine-health.com states that almost everyone can benefit from stretching the soft tissues in the body. This website also states that patients with ongoing back pain will find meaningful and sustained relief of back pain after increasing motion due to stretching regularly. Studies that have supported this common way of thinking include Khalil et al. (1992) and Hayden, Van Tulder, and Tomlinson (2005).

Due to this common belief that stretching improves pain, individuals in this study may have been encouraged to stretch in order to fix their back pain. This may have been a reason for the results to show high severity back pain levels for groups incorporating stretching into their workout regimen. The back pain reported for the groups involving stretching may have been pre-existing pain that led them to incorporate stretching regularly.

This study contradicts society’s lesson that stretching helps with pain severity levels. Additionally, many recent research articles, along with the present study, conclude that more research needs to be done on whether or not stretching really is effective for all individuals. Since no answers to this question have been provided with clarity and since no study has been able to more accurately prove the case for or against stretching, the heated debate on this topic that exists needs attention and priority in future studies.

**Pilates, Core Training, Stretching, and Back Pain**

The lowest back pain level found in this study’s results was shown by the individuals participating in the pilates, core training and stretching combined group.
This group, however, still exhibited a high back pain level as well. The reason for this group having the lowest severity of pain may be due to the incorporation of accumulating more exercises that strengthen the core, when compared to the group only participating in pilates and stretching, but not doing any core training. Core Training is also often incorporated during and at the end of strength training classes, which means that groups including core training in the workout regimen may have a more effective and equal balance between stretching and strengthening exercises. This balance could provide a significant effect on improving back pain. More studies, however, need to be done to determine the effectiveness of this concept.

Core Training, in general, more commonly activates the more superficial muscles of core like the Rectus Abdominis and Obliques, whereas pilates exercises recruit the Transversus Abdominis and the lumbo-pelvic region more often. In this study, the groups incorporating core training compared to the groups incorporating pilates exercises showed no difference in the severity of back pain. It is, therefore, still unclear whether pain management and injury prevention are due to the condition of the core from common core exercises or from the specific nature of the core exercises in pilates or both.

Future Research

More attention needs to be given to the specific benefits attained from core training only, pilates only and core training and pilates combined. Unfortunately, in this study, these groups were excluded from the analysis due to their small sample size. Future studies should make large sample sizes per group an important
consideration so that no group is excluded for a low sample size. Without isolating each of these groups of exercises, it is hard to determine their effect on the severity of back pain levels so future studies should completely isolate these exercises for a more accurate analysis. Suggestions for future studies to determine the effects of pilates only are to distribute questionnaires at a private pilates studio where class sizes are small, where a certified pilates instructor teaches the pilates exercises and where pilates is the only type of exercise being performed in that facility. Additionally, it would be important to make sure that the participants are only performing pilates exercises and not incorporating other types of exercise, including stretching, into their workout regimen.

Conclusion

In this review on the effects of pilates, core training, stretching and physical activity on the severity of back pain, the current author concludes that none of these activities show a different effect on the severity of back pain. The researcher recommends that pilates, core training and pilates along with core training combined be reviewed separately to determine their effects on the severity of back pain. Additionally, future studies should focus on what factors may show statistical differences in improved levels of low back pain and a lower number of incidences of low back pain so that effective treatment strategies can be implemented and can be better understood.
APPENDIX A

Activity Questionnaire
Activity Questionnaire

Anonymous #:________

Please answer and circle Yes or No for the following questions:

1. What is your Gender? Male Female

2.) Do you stretch before exercising? Yes No

3.) Do you stretch at the end of each exercise session? Yes No

4.) If yes, do you hold each stretch for at least 20-30 seconds? Yes No

5.) Have you had low back pain for at least three months? Yes No

6.) If you have had low back pain, please circle the number on the scale below that represents your most common level of pain:

Continue on the back of this page……
Please complete the following table indicating the activities in which you participate:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Please place a check in the box below if you participate in the activity listed.</th>
<th># of Days/week</th>
<th>Duration (min.)</th>
<th>Length of time of Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoga</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretching</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Weight Training</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Zumba Class</td>
<td></td>
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<tr>
<td>Kickboxing Class</td>
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<tr>
<td>Aerobics</td>
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<tr>
<td>Bootcamp Class</td>
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<tr>
<td>Treadmill</td>
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<tr>
<td>Bike</td>
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<td>Stairmaster</td>
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<tr>
<td>Elliptical</td>
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<tr>
<td>Tennis</td>
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<tr>
<td>Core Training</td>
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<tr>
<td>Step Aerobics Class</td>
<td></td>
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</tr>
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<td>Running</td>
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<tr>
<td>Walking</td>
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<tr>
<td>Other</td>
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</tr>
</tbody>
</table>
If you have any questions, please feel free to contact Heather Kreutz, B.S., AFAA, STOTT at hkreutz@hotmail.com, Dr. Parker, PhD at (916)-278-6902 or parkerd@csus.edu or Dr. Edwards, PhD at edwardsb@saclink.csus.edu
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