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# Affective Response And Pain Measurement Correlations In A 500 Mile Pilgrimage: El Camino De Santiago

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# Affective Response And Pain Measurement Correlations In A 500 Mile Pilgrimage: El Camino De Santiago

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by

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*Abstract*

Previous studies have demonstrated a link between affective characteristics and pain measurements in relation to exercise, but the extent to which these links might apply to long term exercise has not been investigated.

**PURPOSE**: To determine the link between psychological response and pain perception over the course of an extended period of high volume-low intensity exercise.

**METHODS**: A PANAS-X survey and a pain measurement questionnaire for 15 pilgrims (10 female, 5 male; 21.06 yrs) were assessed at 7 different points. One PANAS trait survey was completed prior to departure (pre), 3 PANAS state surveys were completed at 3 different times (AM, midday, PM) within the first three days of walking and another 3 PANAS trait surveys were completed at 3 predetermined rest points (rest1, rest2, post).

**RESULTS**: Specific negative affects (state and trait) were correlated with the perception of current pain for all time points except rest day 1 and post ($r= 0.725$ pre, 0.596 AM, 0.673 midday, 0.597 PM, 0.550 rest2; $P < 0.05$). Negative affect (state) was also correlated with perception of worst pain at all time points ($r= 0.653$ AM, 0.572 midday, 0.515 PM; $P < 0.05$). Sadness (state) was most highly correlated with best pain in the evening (pm) ($r= 0.882$; $P < 0.05$). Sadness (trait) was most highly correlated with current pain level (pre)($r= 0.754$; $P < 0.05$).

**CONCLUSIONS**: Pain perception was identified as a strong predictor of negative affects throughout the pilgrimage. Most notably, sadness was the strongest correlate with pain measurements throughout the extent of the study except at the end of the pilgrimage. Therefore, it appears that both psychological state and trait characteristics can predict pain perception during a period of high volume- low intensity exercise. Future studies should be

conducted in order to determine how to alter affective response so that pain perception and injury rates can be reduced and improved.

## Background

### *The Camino de Santiago*

The Camino de Santiago is a religious pilgrimage with over 1,200 years of history. It can be translated as 'the way of St. James' and it is termed as such because the final destination is the Cathedral in Santiago de Compostela, the Spanish city where the remains of St. James are said to be buried. The way has been of major importance since its inception, ranking with Jerusalem and Rome as one of the three major destinations for medieval pilgrims. The pilgrimage gained a massive following and remained a major component of the catholic faith from the 12$^{th}$ century until the 16$^{th}$ century, when European wars made travel throughout the continent less safe and the protestant reformation changed the public sentiment toward indulgences and pilgrimage.

The modern Camino is very similar to its medieval predecessor with a few major differences: the infrastructure that arose in the past is still present on the Camino, with municipalities, churches and private parties running albergues or refugios, hostel like lodging facilities, for the pilgrims. The paths themselves are still very similar or as similar as possible to old medieval routes, and this was insured by scholars of the Camino who worked to reestablish the pilgrimage tradition in conjunction with the provincial governments of Spain. The major differences between the modern and the medieval pilgrimage start at the motivation for the pilgrims. In the past, participation in the Camino was a deeply religious experience. While some of today's pilgrims may have spiritual motivations, they also exhibit motivations that run the full gambit from religious to sport (americanpilgrims.com, 2011).

At its core, the Camino de Santiago is a long term bout of high volume, low intensity moderate exercise. The form of the Camino in question is approximately 789 km or 500 miles, beginning on the border between Spain and France in the town of Roncesvalles and ending in Santiago de

Compostela. While there are many recognized pilgrimage routes through Spain to the resting site of St. James, the Camino Frances is the largest in terms of number of pilgrims using this route and also in terms of infrastructure, and thus it is representative of the most common Camino experience.

A study was performed by Wolf and Harris (2007) in which the physiological effects of the Camino were tested. In this study, the Camino was also identified as a bout of high volume, low to moderate intensity exercise. The study measured body weight, body fat percentage, blood pressure, and fitness levels throughout the course of the 789 km pilgrimage, and found that all of these parameters decreased or improved over time. The results of the study demonstrated that the pilgrimage is performed at an average intensity of 55% of maximum heart rate. The study also paid particular attention to the level of C-reactive protein (CRP) in the subjects, and tested the levels of this protein both prior to and after the pilgrimage. No significant changes were seen in the CRP levels in the pre or post pilgrimage testing, and it was hypothesized that this was due to adaptation by the subjects. The researchers stated that a mid-pilgrimage test might have been able to identify changes in CRP prior to complete adaptation (Wolf & Harris, 2007).

A similar study was performed by Bemelmans et al (2009). This study varied in that it looked at subjects performing a shorter portion of the Camino (280 km), but included more extensive testing. In the study, 29 subjects performed the pilgrimage, while another 29 subjects acted as a control group and performed no exercise. Subjects were tested for HDL cholesterol, LDL cholesterol, weight, and other cardiovascular risk factors both 2 months and 2 week prior to the Camino and at the same time intervals after completion of the Camino. The subjects who performed the pilgrimage were also tested for these cardiovascular risk factors every other day

during the pilgrimage. The results showed an increase in HDL cholesterol and a decrease in both LDL cholesterol and weight. There was, however, no change in vascular function when compared to the control group (Bemelmans, et al., 2009).

This study also identified the Camino as a high volume, low to moderate intensity bout of exercise. The cardiovascular benefits that accompany such a regimen were investigated and demonstrated by the Wolf and Bemelmans studies, and this study aimed to further those efforts by investigating the mental and emotional adaptations and responses that paralleled and coincided with the physiological ones. Although the intensity was low, the high volume (duration and frequency) increases the likelihood of pain and this study aimed to: 1) investigate the perception of pain by the subjects and 2) determine how that perception related to the affective response experienced by those subjects. An understanding of this relationship can improve the knowledge base behind exercise prescription, leading to improvements in adherence and ultimately leading to the important goal of improved cardiovascular health for the population as a whole.

There is a lack of research into the role of pain perception and affective response on exercise adherence and motivation. Psychological studies should focus on high volume low intensity exercise because this is the form of exercise through which at risk individuals can realistically hope to see the greatest health benefits. Such studies would also do well to focus on a younger population, so that progress can be made in understanding how to instill strong health habits at the early stages of adulthood. An event which is largely understudied from the perspective of the exercise researcher and may be able to fulfill all of these desired characteristics is the Camino de Santiago.

*Affective Response and Exercise Intensity*

Exercise Psychology can play many important roles which include assessing the value of exercise and physical activity on the mental state of an individual. While the physiological benefits of habitual physical activity are more widely known, the psychological benefits of participating in an exercise regimen can be just as important and rewarding. In some instances, the mental health of an individual can actually be of greater importance than physical health because of the way that it affects physical health and quality of life. Overall, studies have in fact shown that participation in physical activity is directly correlated with higher psychological health scores, and an overall greater satisfaction with life. Conversely, physical activity has been shown to decrease negative psychological illnesses or afflictions such as depression and anxiety (Schneider & Graham, 2009).

An individual's affective, or emotional, response to any activity has a large impact on their perception of that activity. Any activity that elicits a positive affective response would create a positive perception and reinforce the motivation for future participation, while any activity with a negative affective response would in turn elicit the opposite reaction. Studies have shown that the logic of this hedonic principle extends to exercise and more specifically, exercise adherence. Affective response has been correlated with exercise adherence over 6 and 12 month periods (Schneider & Graham, 2009). Also, studies have shown that personality can play a role in an individual's perception of exercise and thus on their likelihood to remain physically active throughout adolescence and adulthood. Studies have in fact shown that the personality quality of extraversion, or the tendency to experience a positive affective response, is the most highly correlated with exercise participation of all of the tested personality qualities (Schneider &

Graham, 2010). A greater understanding of personality types, and their inclinations or aversions to exercise programs, could be a major breakthrough in the battle to create behavioral change in the population as a whole and would aid in promoting lifelong exercise participation in the adolescent populations.

Exercise intensity has also been shown to play a key role in affective response. Ventilatory threshold, which can also be defined as the lactate threshold, is the point in progressive exercise at which the increase in ventilation, or carbon dioxide removal, increases beyond the increase in oxygen uptake. Studies have demonstrated that below or around ventilatory threshold, there is variability in the response to exercise, with the majority of respondents demonstrating a positive affective response; above ventilatory threshold, the response is largely negative. When given the opportunity to self-select the intensity of an exercise bout, most subjects will select an intensity that is near their individual ventilatory threshold; this fact reinforces the hedonic principle in its relationship to exercise (Rose & Parfitt, 2010). Even in studies in which the participants are not allowed to choose their own exercise intensity, exercise above the moderate level, regardless of personality type or fitness level, exercise above the moderate level will result in a negative affective response (Starr, Houle & Coghill, 2010). If an individual hopes to make a positive behavioral change and incorporate physical activity into his/her habitual routine, he must find a way to exercise so that he experiences a positive affective response. More simply, individuals must find a way to enjoy exercise if they wish to make it a part of their normal routine. This study aims to investigate how individuals approach high volume exercise in terms of motivation and preparation, and how they experience the exercise through affective responses and pain. An improvement in the understanding of individual pain perception and affective response, and how they interact, may result in more realistic and effective exercise prescription.

*Measurement Methods: PANAS*

Many of studies which provide data on affective response utilize objective measurement devices to determine physical activity levels. Devices such as pedometers and accelerometers can be worn throughout the day and provide an accurate picture of total physical activity and energy expenditure. Subjects can then complete questionnaires or surveys to assess their psychological state. One of the surveys which is often used to assess the psychological state of an individual is the *Positive and Negative Affect Scale* (PANAS). In its short form, the PANAS survey is a 20 point survey which can determine positive and negative affects with 10 questions to each affective variable. The survey can be used to determine the affective state or trait characteristics of an individual, and it has been shown to be a valid and reliable measure of these characteristics (Crawford & Henry, 2004). The PANAS survey can assess negative affect through the subject response to questions of feeling: afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset and distressed. The basic positive affect is composed of feelings of: active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud, and strong.

The 20 point PANAS survey has also been expanded into the PANAS-X, which can assess a greater variety of positive and negative affective characteristics. These characteristics include responses on the Basic Negative Emotion Scale such as sadness, which is composed of the subject responses to questions of feeling sad, blue, downhearted, alone and lonely. It also includes responses on the Basic Positive Emotion Scale such as Self-Assurance, which is composed of the 6 feelings of: proud, strong, confident, bold, daring, and fearless. Studies have used the PANAS survey in order to assess the affective state of subjects as it related to the quantity of physical activity with positive results. Parker et al showed that steps per day as measured by a pedometer showed a strong correlation with the affective scales in older adults;

this measurement showed a predictive quality for both positive affect and negative affect scores, accounting for 8.3% and 12.3% of the variance respectively (Crawford & Henry, 2004).

The affective response by both trained and untrained individuals to exercise at various intensities, light, moderate, and hard, was measured using the PANAS scale by Boutcher, McAuley and Courneya (2011). In the study, subjects completed three individual 10 minute bouts of exercise on a treadmill at the three defined intensities. The results of the study showed that trained subjects demonstrated increased positive affect responses to the moderate and hard exercise bouts, while the untrained individuals demonstrated decreased positive response to all forms of exercise (Boutcher, McAuley & Courneya, 2011). Such a use of the PANAS scale to understand the response to exercise can play an important role in exercise prescription and adherence. The Boutcher, McAuley and Courneya study demonstrated that trained individuals have a more positive response to exercise, which in effect will reinforce the to desire to perform exercise, and subsequently lead to even greater health and fitness.

The overall connection between physiological and psychological factors in exercise performance was demonstrated by a study performed by Lord and Menz (2002). In the study, the performance of an elderly population in a 6 minute walking event was examined in how it correlated with a variety of measured variables. Among the psychological surveys utilized was the PANAS survey, and the results showed that all of the physiological and psychological parameters that were examined were associated with performance in the 6 minute walk (Lord & Menz, 2002). Studies such as this demonstrate the overall complexity and multivariate influence on physical activity and wellness; they make the need for research on all aspects of human well being, including the mental, emotional, spiritual and physical, all the more apparent.

*Group Exercise and Motivation*

Another aspect of exercise adherence and motivation which may have played a role in this study is the environment in which exercise is performed. Group exercise or other methods of social support have shown to be incredibly important and strong predictors of exercise adherence and behavior change. Among the ways in which social support is believed to directly improve health is by decreasing stress and thus leading to improved cardiovascular health, though studies have failed to prove this conclusively. In one study performed by Christian and Stoney (2006), the systolic and diastolic blood pressure of a patient were not significantly changed due to the presence of a companion in a stressful situation as compared to individuals who were alone, however those with a companion displayed less deleterious vascular response (Christian & Stoney, 2006)

Group based exercise programs have also been shown to demonstrate positive effects on performance in response to training programs. In a study performed by Brown, Ambrose and Lord (2009), a group of senior aged individuals were randomly split into three groups, one of which took part in a group based general exercise program. In the group which performed a group based exercise program, there was a significant increase in performance in fluid intelligence, and all exercise modalities demonstrated increased positive affect scores and improved moods over the course of the 6 month program (Brown, Ambrose & Lord, 2009).

Overall, group support and membership has been shown to demonstrate positive benefits toward exercise adherence and performance. While the physiological component that allows for such benefits is not completely understood, there is little question that participation in group based exercise programs can lead to positive physiological changes which include improved cardiovascular health, and also improved mental health and wellbeing as demonstrated by the

increased positive affect response displayed by group exercise participants. These results demonstrate that the use of group exercise programs could prove to be a critical tool in the creation of positive exercise patterns within the community at large. Study of the Camino de Santiago, which was performed as a group in this study, could help to reinforce this notion.

*Pain Perception and Exercise*

It would seem logical that the perception of pain can play a key role in an individual's motivation and self efficacy in maintaining an exercise regimen, that is to say that an individual who experiences a greater degree of pain or has a lower pain tolerance will be less likely to adhere to an exercise program. Physiologically, pain can arise from many sources including muscle, tendons and bone, and while the biochemical and physiological causes and ramifications of pain sensation are well understood within the scientific community, it is the psychological implications of pain that are of major importance to those attempting to create positive behavior changes in the general population.

The correlation between affective responses and pain perception in exercise psychology is a field that is underdeveloped. The promotion of habitual exercise participation may require this information if it wishes to address the issue on an individual level and understand the pain tolerance and limitations that each individual possesses. One study performed by Starre, Houle, and Coghill (2010), attempted to gain a better understanding of the variability in pain sensitivity and experience in response to heat. The study used a series of surveys including the PANAS-X in order to create a model that could accurately predict a large segment of the variability in pain experience (Starr, Houle &Coghill, 2010).

The connection between pain tolerance and sensation and exercise motivation and adherence is a field that is altogether under-investigated and should be pursued in order to gain a better

understanding of the situation at hand. The most applicable study identified by the investigators was performed by Staes, Stappaerts, Lesaffre and Vertommen (2007) it explored the relationship between lower back pain and the effect that social support and effect have on that pain. The study concluded that further research needed to be conducted in order to understand the relationship between pain perception and psychosocial factors that may influence that perception (Staes, Stappaerts, Lesaffre, & Vertommen, 2007). The conclusions of this study further emphasize the need for continued research into this field.

While this study aimed to examine the experience of pain as a result of exercise, other studies have gone on to show how exercise can help those with chronic pain ailments. Cook et al (1997) performed a study in which individuals with chronic pain were prescribed an exercise regimen by their physicians, and were told to perform the exercise until pain or fatigue set in; the subjects were given the option of when to continue and when to cease the exercise. While physicians consistently prescribe reduced exercise to patients with chronic pain ailments, the results of this study demonstrate that the opposite might actually be more appropriate. This study showed a negative correlation between exercise and pain, which meant that the more exercise the patients performed, the less pain they reported experiencing (Cook et al., 1997).

This study utilized a 10 point scale in order to assess pain perception in the subjects. Other researchers have used such a scale and have proven its validity. Cook et al used just such a scale in a series of projects in which subjects were asked to perform a variety of exercise bouts on a cycle ergometer. In one of these studies, subjects were asked to perform a ramped maximal test and to press a button at the point at which pain threshold was reached. This test showed that pain threshold was reached at approximately 50% of maximal capacity, and that exhaustion was reached at a pain rating of approximately 8.2, which was associated with the verbal cue of “very

strong pain" (Cook et al., 1997). This study demonstrates the validity of using a pain scale, and more specifically a 10 point pain scale, in assessing the pain perception of subjects in response to exercise. An understanding of how subjects respond to exercise in the form of short but intense bouts is important, as is an understanding of how subjects respond to a low intensity but very high volume exercise such as the Camino de Santiago.

The wealth of information that is available regarding the psychological impact of exercise and the factors that play a role could be utilized as a whole to create a better understanding of the population's relationship with exercise and how to improve and strengthen that relationship. Many of the tools and measures discussed above such as goal oriented exercise, group based exercise and the PANAS psychological survey could be studied and used in the future in order to create more realistic and personalized exercise prescription. This can lead to a more active population, a population that can more readily and willingly meet the exercise recommendations proposed by authoritative bodies such as the AHA and the President's Council for Physical Fitness and Sport.

*Adherence and Motivation*

As previously stated, the connection between physical activity and general health, including cardiovascular health, is well established. It is so well established in fact that physical activity has become a common prescriptive tool for physicians and a key area of focus for government agencies. Although the benefits of physical activity are well established in the lay population as well, a major area of concern for the governing bodies is the lack of adherence to exercise regimens. Some studies have shown a dropout rate of as much as 50% within 6 months of commencing an exercise program. The importance of physical activity to health and quality of

life are what has made exercise adherence and motivation factors a key area of interest for exercise psychologists in recent years.

In order to study motivation in exercise adherence, psychologists first had to create a vocabulary with which to discuss the concept. A key concept in this vocabulary is the difference between an intrinsic motivation factor and an extrinsic one. Intrinsic motivation factors are those that come from participating in the activity itself, such as enjoyment or challenge while extrinsic factors are those that come as a result of participation, such as improved body composition. Researchers have conjectured that while both intrinsic and extrinsic factors play a role in an individual's participation and adherence to an exercise program, it is intrinsic motivation which plays the greatest role in maintaining long term adherence for physical activity. This can be simplified to say that those who enjoy an activity will continue to participate while those who do not are more likely to give up over time. Research does in fact support these logical conclusions, with some studies showing that the initial motivation for participating in an exercise regimen can be predictive of one's eventual adherence to that regimen (Oman et al., 1998).

Other researchers have identified different key concepts in the study of exercise adherence, which are the notions of self-efficacy and goal orientation. Self efficacy is defined as the ability of an individual to exert control over themselves and their lives; it can be more commonly referred to as will power. Research has shown that self efficacy is a crucial component for exercise adherence but that when acting independently it may not be enough. More definitively, self efficacy is important in the early adoption of an exercise program but is not predictive of exercise adherence over a long term study (Hallam et al., 2004). In fact supervision has been demonstrated to play a key role in adherence to exercise programs. In one study, within the

span of four 60 minute exercise sessions administered over the course of two weeks, participants demonstrated an increase in self-efficacy. In the group with supervised exercise programs there was a 67% adherence to exercise over the course of twelve months, whereas a control group which was not supervised declined to just 12% participation over the same 12 month period (Shilts et al., 2004).

*Exercise Goals*

The Camino de Santiago is a unique form of exercise in that it has a clearly defined goal or end point. A further investigation into the effects of creating such a form of exercise can enhance the understanding of the psychological response to the Camino experience and to the motivations that lead to initial participation and completion of the Camino. The use of goal oriented programs is common place in many settings, including the field of medicine. Goal oriented treatment has been used by physicians in the control of pulmonary arterial hypertension, to name just one example, and it has demonstrated significant levels of success and limited the necessity for more drastic treatments for those individuals. In a Hoeper et al (2005) study, a goal oriented therapy strategy which included the use of multiple medications for pulmonary arterial hypertension showed a large increase in survival rate as compared to control and historical groups and also decreased the need for more invasive treatments such as lung transplants (Hoeper et al., 2005). Research on goal setting in changing exercise behavior has been varied in terms of focus and results. There are those studies which focus on the effectiveness of goal setting as a means of producing behavior changes. These studies have given mixed results as to the true utility of goal setting in an intervention, but the majority of these studies have supported the use of goals in the movement to create positive behavior changes (Martin & Sharpe, 2011).

Another form of goal setting research examines the effectiveness of the different types of goal setting. The different goal setting methods can be categorized as being either self-set, assigned, participatory or collaborative; these categories examine the source of the goals within the program. Studies have shown that programs that utilized assigned goals are more effective than those that utilize self-set goals. Goal setting programs can also be categorized based on components of the program, such as the use of rewards or feedback, and properties of the program, such as proximity, specificity and difficulty of the goals. Studies that have examined the effectiveness of proximal vs. distal goals have shown that distal goals may provide better results but can also lead to a declined rate of adherence. The results from other such studies are not consistent enough to be completely confident in the data (Shilts et al., 2004). The vast varieties of goal setting programs and the lack of research on these varieties is a gap in the literature which requires analysis and further research.

A third form of goal setting research analyses the effectiveness of goal setting interventions and education programs. These studies are not meant to determine the effectiveness of the goal setting as a means of producing a behavior change, but rather they are meant to examine the effectiveness of goal setting as opposed to interventions that do not include goal setting. The studies have shown the intervention and education programs that include goal setting are more capable of producing a behavior change than the intervention programs that do not (Martin et al., 2011). Once again, the lack of depth into this field of research and even more specifically the lack of research into the use of goal setting as a means of creating behavior change in child and adolescent populations leaves much to be desired.

As the research begins to fill the holes in this increasingly important area of knowledge, the value of both self efficacy and goal oriented exercise programming continues to become more

apparent. A recent study by Martin et al. (2011) used questionnaires to determine the self efficacy and goal oriented characteristic levels of its participants prior to and throughout an exercise program. The study then found that there was a direct correlation between the level of these characteristics and exercise participation within the group (Martin et al., 2011). Once again, the ability to create behavioral changes within the population is becoming increasingly more important as the epidemics of diabetes, obesity and other controllable illnesses continue to ravage the U.S. and world populations. Goal setting interventions and measures of self-efficacy have been shown to play a role in exercise adherence and in motivation levels, and researchers must continue to pursue these lines of study in order to better understand and utilize these tools. Self-efficacy has also been shown to have a strong relationship with a subject's emotional response to exercise, and this line of study is incredibly important in order to fully understand the role of exercise on the human body. All of the psychological elements and their impact on pain perception and exercise adherence are imminently applicable in the current state of population health. An understanding of cardiovascular health, the role of exercise in cardiovascular health, and the overall lack of fitness in the U.S. population can further testify to the value of this research.

*Cardiovascular Disease*

Understanding the emotional and psychological response to an exercise regimen such as the Camino de Santiago is important because of the impact that undertaking such a regimen can have on cardiovascular health and fitness. With the current epidemic of obesity and cardiovascular disease that is sweeping across the entire world, it is becoming increasingly evident that an investigation into all aspects of cardiovascular disease and exercise could be of potential benefit. A further understanding of the nature and impact of cardiovascular disease on

individuals and the world as a whole is important in understanding the true value of these studies.

Cardiovascular disease (CVD), or more commonly, heart disease, is the leading cause of death in the United States. This umbrella term includes heart attacks, and more commonly coronary artery disease, which can manifest itself through angina, arrhythmias and even lead to heart attacks (Center for Disease Control and Prevention, 2009). CVD can also include high blood pressure (hypertension), strokes and heart failure. With such a large grouping of illnesses, it is of little wonder that CVD has claimed as much attention from leading health officials. The American Heart Association (AHA) reported that in 2006, 81,100,000 Americans had at least one of the manifestations of CVD and that 831,272 deaths or 34.3% of all deaths resulted from CVD. This number includes the staggering 151,000 deaths of individuals who were below 65 years in age. When compared to the mortality rates of other prominent diseases, the numbers become all the more staggering. In the same year as the AHA report, cancers lead to 559,888 deaths while HIV/AIDS resulted in 12,113 deaths (American Heart Association, 2011).

If this isn't enough to convince of the truly harrowing affects of CVD, the economic impact of the disease must be considered. The American Heart Association (AHA) estimated that for the year 2010, the cost of treatment for individuals with CAD was $273 billion and that the loss of productivity from those suffering from CAD resulted in the loss of another $172 billion. The AHA also predicts that these figures will rise to even greater levels, with the total cost of CAD elevating to $818 billion and the loss of productivity amounting to $276 billion by the year 2030 (American Heart Association, 2011). With so many lives and even more dollars at risk, it is incredibly pertinent that the lay population acquire adequate knowledge as to the causes, treatments and preventions of CAD.

Coronary artery disease (CAD) results from the buildup of plaque in the arteries which supply blood to the heart. As the plaque builds up in these arteries, it can lead to the narrowing of the passages, causing a restriction of blood flow to the muscle of the heart. This process of narrowing is referred to as atherosclerosis and can lead to oxygen deficiencies and eventually cell death in the heart muscle, or myocardium. Other signs and symptoms of CAD include angina, which is defined as chest pain associated with the diminished blood flow to the heart (Center for Disease Control and Prevention, 2009). CAD is the leading cause of death in the United States with 425,425 deaths being reported by the AHA in 2006 (American Heart Association, 2006).

As the most deleterious consequence of CAD, heart attacks or myocardial infarctions are of major importance and interest to the lay population. A myocardial infarction is defined as the injury or death of heart muscle due to reduced blood flow and it is most commonly a result of CAD (Center for Disease Control and Prevention, 2009).

*Cardiovascular Disease Risk Factors*

An indicator and precondition for CAD, and more specifically atherosclerosis, is blood cholesterol levels. In one study, it was shown that as many as one third of all CAD incidences occurred in individuals with a cholesterol level above 200 mg/dl. The current national average is 210-220 mg/dl, which is a rather alarming statistic when considered with the relationship to CAD (Ridker, 2001). The cholesterol which has been most closely associated with risk of CAD is low density lipoprotein (LDL). This form of cholesterol has been shown to have a positive correlation with risk and occurrence of CAD on a linear scale. High density lipoprotein (HDL), on the other hand, has been shown to demonstrate positive effects in that it decreases the risk of CAD (Ballantyne, 2002). This information has lead to the formation of cholesterol guidelines by

health organizations. The National Institute of Health (NIH) published its own guidelines in 2001, stating that the optimal LDL level was anything less than 100 mg/dl and that any amount greater than 60 mg/dl was the optimal level for HDL. The desirable level for total blood cholesterol was set at less than 200 mg/dl (National Institute of Health 2001). Studies have shown these guidelines to be accurate in terms of minimizing the risk of CAD (Ballantyne, 2002).

The NIH has also outlined other major risk factors to be examined when determining the risk of CAD for an individual. These risk factors include smoking, hypertension, family history and age (National Institute of Health, 2001). These are certainly not the only factors that are associated with risk of CAD, as the AHA and other organizations have also included gender, physical inactivity, obesity, diabetes, stress and alcohol use as other factors to be considered and monitored when assessing an individual's risk of CAD (American Heart Association, 2011).

Smoking, or any use of tobacco products, has been deemed to be one of the greatest controllable risk factors of CVD. The deleterious effects of tobacco are widespread, and it has been cited as a cause of numerous other chronic illnesses, including many types of cancer, chronic obstructive pulmonary disease (COPD), and atherosclerosis. The surgeon general has gone so far as to say that smoking is, "the leading preventable cause of disease and deaths in the United States." In fact, the use of tobacco has been shown to augment the impact of other previously discussed risk factors for CVD such as lowering the levels of HDL. Tobacco use has also been shown to increases blood pressure and decrease exercise tolerance (American Heart Association, 2011). Some studies have shown that as much as 30% of all CAD incidences can be attributed to smoking and that overall, the use of tobacco products account for an estimated 430,000 deaths per year (Ockene et al., 1997).

A second controllable risk factor of CVD is hypertension or high blood pressure. Blood pressure is measured as a result of the force exerted by the heart to pump the blood through the body and the resistance offered to the force by the arteries. This means that the more blood that is pumped by the heart and the narrower the arteries, the greater the measured blood pressure (Center for Disease Control 2010). Hypertension is measured with two numbers; the first is known as systolic pressure and is a measure of the pressure during the contraction of the heart. The second number is termed diastolic pressure, and is a measure of blood pressure while the heart is at rest. A blood pressure measurement of 120/80 has been deemed to be pre-hypertensive, which means that any individual with this measurement is at risk of developing hypertension. A measurement of 140/90 is termed stage 1 hypertension, while any reading of 160/100 or higher has been termed stage 2 hypertension. It has been estimated that 1 in 3 adults in the United States currently has hypertension (National Heart, Lung and Blood Institute, 2011). Lower estimates for hypertension in the American population are at 17.4%, and these estimates have been used to calculate the economic costs of treating hypertension to be nearly $55 billion for the year 2001(Poirier et al, 2005).

A third controllable risk factor for CVD as designated by the AHA is obesity. Obesity is defined as being at a weight that is greater than what would be considered a health living weight for an individual. While there is some variability in what is considered a healthy living weight, for most individuals, the measurement of “body mass index” (BMI) is a reliable tool. The BMI of an individual is calculated by indexing the height and weight of an individual, and these two measurements can be used to relatively accurately assess an individual’s fat content. An adult with a BMI measurement of 25 to 29.9 is considered to be overweight, while an adult with a measurement of 30 or above is considered to be obese (Weight control information network, 2011). Along with BMI, the National Institute of Health and the National Heart, Lung and Blood

Institute recommend a waist circumference measurement and the assessment of other risk factors, which include hypertension, high cholesterol, and smoking, as a means of determining the individual risk for developing diseases associated with obesity (Center for Disease Control and Prevention, 2011).

The grave health risks associated with obesity are well established, with obesity being shown to drastically increase mortality rates even when adjusted for age, cholesterol levels and smoking. In a long term study of 31.5 years, it was shown that a BMI above the 95$^{th}$ percentile was predictive of mortality rates in 80% of female cases and 100% of male cases. It is believed that obesity creates a deleterious effect on the cardiovascular system by increasing the amount of adipose tissue and thus the demand for blood flow on the heart. Aside from the negative impact of increased vascular demand, adipose tissue is also known as an endocrine organ. The increased ratio of adipose tissue in obese individuals leads to increase in many hormones. One of these hormones, simply as an example is IL-6, which signals CRP production in the liver. CRP acts as a signal of chronic inflammation and can act to cause acute coronary syndrome (Sloan, 2010). All of this simply proves that the negative impact of obesity on the human bind is as varied as it is far reaching.

The CDC has estimated that in the United States, one third or 33.8% of all adults above the age of 20 are obese, and that 68% are overweight. These rates have steadily increased since the early 1970s for all age groups, genders, and racial/ethnic groups. With such a high prevalence in the population, it comes as no surprise that this disease is taking a terrible cost on the individuals who suffer from it. Obesity has been linked to an excess CVD disease mortality of 112,000 per year. If these individuals are not dying from obesity, than they are surely paying the price for their disease as obese individuals have been estimated to spend $1,429 more for

health care than a normal individual. This represents a 42% difference between those who suffer from obesity and those who do not (World Health Organization 2011). In 1998, estimates for the cost of obesity on the nation's health care system ranged from $26.8 billion to 47.5 billion. As a sign of the alarming increase and prevalence of obesity in the population, more current estimates are nearing $170 billion (Office of the Assistant Secretary for Planning and Evaluation, 2002) (New York State Department of Health, 1999).

The final controllable factor for CVD to be discussed, and the one which may play the greatest role in controlling not only CVD but all of the other controllable risk factors is physical inactivity. Physical activity is defined by the World Health Organization (WHO) as any movement which originates from the skeletal muscles and requires the use of energy, thus physical inactivity can be defined as the lack of such movements. The WHO also estimates that physical inactivity and the chronic diseases that can result cause 1.9 million deaths around the world (World Health Organization, 2011). The benefits of physical activity for individuals of any age have been well documented; one study performed in 1993 claimed that physical inactivity and diet could be attributed for 14% of all deaths in the United States. Similarly, another study linked 23% of all deaths from chronic diseases to a sedentary lifestyle (Health and Human Services, 2002). To further establish the prevalence and risks of a sedentary lifestyle, consider the fact that coronary artery disease, with a mortality of 700,000 deaths per year, is the number one cause of death in the United States. Physical activity is estimated to account for 35% of all deaths from coronary artery disease. This should come as no surprise for a population in which 60% of all adults report participating in little to no physical activity on a normal basis (New York Department of Health 2009).

It comes as no surprise that physical inactivity has been closely linked to obesity, but it is has also been linked to other risk factors for CVD such as hypertension, diabetes and high cholesterol. Exercise can serve to lower blood pressure by increasing the efficiency of the heart. That is to say that it can augment the heart's ability to pump blood by increasing its stroke volume, or the amount of blood that it can pump with every beat. By increasing the efficiency of the heart, this allows the heart to do less work while still providing the body with its requisite blood supply, and this in turn decreases the pressure on the heart. In some instances, physical activity can be as effective at lowering blood pressure as some medications. It has been shown to decreases systolic blood pressure by 5-10 mm Hg (Fan et al., 2009).

Physical activity has also been used as a treatment and prevention for diabetes mellitus, or Type II Diabetes. Among the many benefits of physical activity for those with Type II diabetes are the increased sensitivity of muscle to insulin, decreased glucose production by the liver, increased muscle mass and weight loss. All four of these positive benefits are key aspects in the control and treatment of type II diabetes (University of Georgia, 2011).

The levels of cholesterol in the blood, both LDL and HDL alike, have also been shown to be variable with physical activity levels. Studies have indeed shown that physical activity can serve to decrease LDL and total serum cholesterol levels while increasing HDL levels. In fact, studies have shown that diet alone is not enough to lower cholesterol levels, and that a regime of physical activity must also be implemented in order to reduce the serum LDL levels[45]. The benefits of physical activity for those with high blood cholesterol are so great in fact that doctors often prescribe physical activity as a treatment. The only flaw with this prescription is the low rate of compliance and adherence and the misrepresentation by patients who self report their levels of physical activity (Ryan et al., 1997).

*The Role of Exercise*

The positive effects of physical activity and conversely the negative impact of a sedentary lifestyle are so well established that in 2008 the United States government released its own guidelines and recommendations for the safe and effective practice of physical activity. For adults, the "Physical Activity Guidelines for Americans  recommends a minimum of 150 minutes of moderate physical activity per week, with this time being spread over at least 3 days. Moderate intensity exercise includes brisk walking or walking at a pace of 3 miles per hour or greater, cycling at a pace below 10 miles per hour, and general gardening. The guidelines also recognize that even higher levels of physical activity are associated with even greater benefits, and so it recommends gradually increases in one's exercise regimen to upwards of 420 minutes per week (American Heart Association, 2011).

Overall, the need to increase physical activity throughout the population of the United States is well understood and is the current emphasis of many organizations. If the health risks associated with a sedentary lifestyle are not motivation enough, then the economic costs of a physically inactive population may also be of interest. In 2002, the President's Council for Physical Fitness and Sports released a comprehensive analysis of the effects of the massive decline in physical activity on the population. In the analysis, it was reported that the costs, both direct and indirect, of physical activity amounted to $150 billion. In the same year, total health care costs for the population of the United States reached $1.3 trillion. This means that 15% of the entire budget for health care in the United States went to sedentary individuals. Studies have shown that individuals who follow the government guidelines by incorporating 150 minutes of physical activity per week into their routine demonstrate a 30% decrease in CVD,

strokes and type II diabetes. This 30% decrease in these chronic diseases would result in a net savings of $119 million for the United States economy.

The exercise recommendations that are made in the “Physical Activity Guidelines for Americans” and which closely mirror similar recommendations made by such governing bodies as the CDC and the ACSM are not unwarranted. These recommendations are in fact based on large amounts of research which point to the incredible value of habitual moderate exercise on physical fitness and cardiovascular health. In one study performed by Nishida et al the influence of low intensity aerobic exercise on insulin-like growth factor-1 was investigated. Insulin-like growth factor-1 and its associated binding proteins play a key role in mediation between Human Growth Hormone and growth response. As a key player in the process of growth, Insulin-like growth factor (IGF-1) has long been associated with cancer and research has indeed shown this to be the case. Individuals with a higher concentration of IGF-1 in the blood have been shown to be more at risk of cancer development thus IGF-1 concentrations have been used as predictors of cancer risk in patients (Stefanick et al., 1998). The Nishida et al (2000) studied demonstrated that low intensity exercise performed 5 days per week over the course of 6 weeks can decrease IGF-1 concentrations by approximately 9%, while also improving insulin sensitivity by 20% (Nishida et al., 2000). It should also be noted that subjects accrued these positive benefits by performing only low intensity exercise. The benefit of improving insulin sensitivity through exercise would appear to demonstrate the benefits of exercise on diabetic patients and this notion has also been supported by research.

Diabetes, and more specifically type II diabetes, is linked to the rise of obesity rates on the national and global stage and as such it has increased in incidence throughout the United States to the point of an epidemic. Diabetes has been identified by the AHA as a risk factor in the

development of cardiovascular disease and a score of negative health ailments. Type II diabetes, the most common form of diabetes, is caused by a decreased production of insulin or a decrease in the sensitivity of the cells of the body to insulin (American Heart Association, 2011). The results of the study performed by Nishida et al would then prove that exercise can prevent type II diabetes by improving insulin sensitivity within the body.

One study which further demonstrates the value of exercise in the treatment of type II diabetes was performed by Sallam et al (2010) and explored the effects of moderate intensity exercise on C-reactive protein (CRP) and aortic endothelial cell function. CRP is of interest to researchers because of its known role in the inflammatory response, high levels of CRP occur where there are high levels of inflammation. This inflammation is associated with atherosclerosis and more generally with increased risk of cardiovascular disease and as such CRP levels have been found to be predictive of cardiovascular disease risk (Sallam et al., 2010). The study performed by Sallam et al (2010) monitored CRP levels and aortic endothelial cell function in diabetic mice and a control group in response to moderate exercise. The CRP levels were found to be significantly higher in the diabetic group at baseline. After two weeks of training, endothelial cell function was found to be vastly improved, and after 6 weeks of training diabetic mice demonstrated improved endothelial cell function and a significant decrease in plasma CRP (Sallam et al., 2010). Further studies have demonstrated the anti-inflammatory effects of exercise and the subsequent benefits for those with diabetes and atherosclerosis. A study performed by Yakeu et al (2010) demonstrated that low intensity exercise could up-regulate the expression of the M2 marker and activate the nuclear receptor PPARy nuclear receptor, both of which have been linked to an improved inflammatory response. The researchers found that the PPARy activation by means of low intensity exercise was very similar to the activation of the receptor by pharmacological means, and so exercise could be used as a reliable means of reducing

inflammation in the body (Yakeu et al., 2010). These studies demonstrate the value of exercise for diabetic patients and also prove the necessity for long term exercise adherence in order to see the full spectrum of positive benefits linked to physical activity.

Another risk factor for cardiovascular disease which has reached the status of epidemic throughout the globe is obesity. Obesity is associated not only with cardiovascular disease but also with the deleterious inflammatory response which has been discussed previously. As mentioned above, low intensity exercise can act through a variety of mechanisms to improve this inflammatory response, but it can also provide other benefits to an obese individual. In a study performed by Lazzer et al (2010), the effects of high intensity exercise were compared to the effects of low intensity exercise on a population of obese adolescents. Those subjects assigned to the high intensity group performed exercise at 70% of their VO2 max and those in the low intensity group worked at 40% of their VO2 max. After 3 weeks, both groups demonstrated a decrease in body mass and fat mass, but the individuals in the low intensity group demonstrate significantly greater decreases in these parameters (Lazzer et al., 2010). These results reinforce the conclusions of the many governing bodies who have recommended low to moderate intensity exercise as a means of improving physical fitness and health. Not only does this mean of exercise provide great benefits, but it is also the most realistic recommendation for a population that is largely sedentary and unaccustomed to exercise of any intensity level.

High volume, low intensity exercise does not only benefit those with chronic illnesses or sedentary individuals. Studies by the New Zealand Academy of Sport have demonstrated that positive benefits of high volume-low intensity exercise for highly trained athletes who compete in high intensity sports such as running or rowing. While the use of high intensity interval

training has been shown to improve performance in high intensity competition by as much as 4%, improved aerobic capacity by means of high volume low intensity training is also of critical importance to performance. The researchers at the New Zealand Academy of Sport have identified a training regimen consisting of 75% low intensity training and approximately 15% at very high intensity to be optimal (New Zealand Academy of Sport, 2011). These studies demonstrate that all individuals, regardless of training history or current health status can benefit by the implementation of an exercise program that includes and emphasizes low intensity exercise.

*Methods*

In order to investigate the relationship between pain perception and affective state, 15 subjects were recruited to participate in the study as they progressed through the Camino de Santiago. The study received approval from the Protection of Humans Subjects Committee of the College of William and Mary in Williamsburg, Virginia. The group of 15 subjects consisted of 10 female and 5 male subjects, with an average age of 21.06 years (range= 19-23). Prior to testing each subject was given a consent form to read and sign.

The subjects underwent seven individual periods of testing, one period prior to commencement of the Camino, five periods during the pilgrimage itself, and one period after completion of the Camino. The first period of testing consisted of the PANAS-X survey (Appendix 1) the Pain Numeric Rating Scale survey (Appendix 2) and a series of questions mean to assess the motivation and level of preparation for the Camino (Appendix 3). The PANAS-X survey given in this case was designed to assess the affective traits of the subjects, and this was done in order to create a baseline assessment of the PANAS-X variables.

Of the five surveys completed during the actual Camino, three were completed in the first three days of walking. These surveys were performed in order to assess the affective states of the subjects at the time of the survey's completion. In order to gain a better understanding of the affective state of the subjects throughout a normal day on the Camino, these surveys were completed at three distinct times throughout a normal day. The first survey was completed after the first full day of walking, the second state survey was completed on midday of the second day of walking, and the third state survey was completed on the morning of the third day, prior to any walking. At the time of completion of the PANAS-X state surveys the subjects were also asked to complete a Pain Numeric Rating Scale survey.

The final series of surveys were once again designed to test the affective traits of the subjects. This series of surveys includes two surveys, one given on each of the designated rest days and the final survey given upon completion of the pilgrimage. The first designated rest day occurred in Burgos after ten days of walking. The second rest day was taken in the city of Leon, six days after leaving Burgos. The final survey which was given in Santiago de Compostela upon completion of the Camino was administered 14 days after the survey in Leon. As stated, these surveys included a PANAS-X survey assessing the affective trait of the subjects and they also included a Pain Numeric Rating Scale surveys in order to assess the pain perception of the subjects.

Once the responses from the surveys had been gathered and the scores from the PANAS-X surveys were tabulated. The relationship between the scores on the Pain Perceptions surveys and the affective response scores was determined by using a bivariate correlation analysis in SPSS.

*Results*

Negative affects (state and trait) was correlated with the perception of current pain for all time points except rest day 1 and post (r= 0.725 pre, 0.596 AM, 0.673 midday, 0.597 PM, 0.550 rest2; $P < 0.05$). Negative affect (state) were also correlated with perception of worst pain at all time points (r= 0.653 AM, 0.572 midday, 0.515 PM; $P < 0.05$). Sadness (state) was most highly correlated with best pain in the evening (pm) (r= 0.882; $P < 0.05$). Sadness (trait) was most highly correlated with current pain level (pre)(r= 0.754; $P < 0.05$).

In the first survey which served as the baseline survey, the average positive PANAS-X score was 36.64±6.48, while the average negative score was 16.64±4.81. The male average for the positive and negative scores was 37.6 and 16.6 respectively, and the female average for these scores was 36.1 and 16.7. In the Pain Numeric rating Scale, the highest level of pain recorded was for usual level of pain in the last week, for which the average was 1.29 (Table 5). For this preliminary survey, there was a strong correlation between the negative score and pain now (0.725; $P < 0.01$) and best pain (0.667; $P < 0.01$) and worst pain (0.639; $P < 0.05$). The sadness score demonstrated a correlation with all of the pain measurements: pain now (0.754; $P <0.01$), usual pain (0.744; $P < 0.01$), best pain (0.751; $P < 0.01$), and worst pain (0.750; $P <0.01$).

In the motivational portion of this preliminary survey, 79% of subjects responded that they were motivated to participate as a physical pursuit while 71% stated that they spent time in physical training for the Camino. Seventy-eight percent of subjects reported having spent between two and eight hours per week physically preparing for the Camino, with 43% reporting two to four hours, 21% reporting four to six hours, and 14% reporting six to eight hours. None of the subjects reported spending zero hours or more than eight hours in physical preparation but 14% disagreed when asked if they spent time in physical preparation. The most common form of preparation as reported by the subjects was taking long walks with the shoes and pack which

would be used during the actual experience. Fourteen percent of subjects stated that a physical pursuit was the number one motivation for participation, while 100% of respondents expected to receive physical benefits from participation.

Seventy-one percent of all subjects either strongly agreed or agreed that their motivation for participation the Camino was spiritual, while 14% were neutral to the statement and another 14% either disagreed or strongly disagreed. Twenty-one percent of subjects stated that a spiritual pursuit was the major motivation for participation in the Camino. Seventy-nine percent of respondents, however, either agreed or strongly agreed with the statement that they expected to receive spiritual benefits from participation, with only 7% responding in the negative. Sixty-four percent of respondents disagreed with the statement that they spent time in spiritual preparation for the Camino, while 43% reported having spent one to two hours spiritually preparing and another 7% reported spending two to four hours per week preparing. The remaining 50% reported zero hours per week of spiritual preparation.

When asked if the motivation for participation in the Camino was an emotional pursuit, 57% of subjects agreed (28.5% agree, 28.5% strongly agree), while 21% were neutral and another 21% disagreed. When asked to rank their motivations for participation, 43% of subjects ranked the emotional pursuit as the number one motivation. Ninety-three percent of all subjects agreed with the statement that they expected to receive emotional rewards by participating in the Camino. When asked to respond to the statement “I spent time in emotional preparation for the Camino,” 28% agreed (21% agree, 7% strongly agree), 42% disagreed (28% disagree, 14% strongly disagree) and 28% of respondents were neutral. Fifty-seven percent of subjects responded that they spent from 1-6 hours per week emotionally preparing for the Camino (36%

1-2 hours, 14% 2-4 hours, 7% 4-6 hours), with subjects reporting that the majority of this preparation time was spent in period of inward reflection and thought.

The second survey administered was designed to assess the affective state function of the subjects after the first day of walking, and as such it was given in the evening hours of that day. For this survey, the average positive affect score for all subjects was 35.73±6.14 and the average negative affect score was 16.67±5.57 (table 6). The average positive and negative scores for female participants were 35.5 and 18 respectively, while the average score for all male participants was 36.2 and 14. In the Pain Numeric Scale, the average score for pain experienced "right now" was 2.73 as compared to 0.64 in the baseline survey, and the average worst level of pain was 3.6 which rose from 2.5 in the preliminary survey (Table 5). The negative affect score for this survey correlated with all pain measurements: pain right now (0.597; $P < 0.05$), usual pain (0.695; $P < 0.01$), best pain (0.712; $P < 0.01$), and worst pain (0.515; $P < 0.05$). Hostility was found to correlate with three of the pain measurements: pain now (0.621; $P < 0.05$), usual pain (0.635; $P < 0.05$), and worst pain (0.527; $P < 0.05$). Sadness was also found to be highly correlated to two of the pain measurements: usual pain (0.729; $P < 0.01$), and best pain (0.882; $P < 0.01$).

The second state survey administered to the subjects was delivered at midday during the second day of walking. The average positive affect score for all subjects was 32.93±8.47 and the average negative affect score for all subjects was 15.26±6.47. The average positive score for all female subjects was 31 and for males the value was 36.8. The average negative score for females was 17.4 and in males the average negative affects score was 11 (Table 6). The results in the Pain Numeric Scale survey resulted in an average "pain right now" score of 3.53 and an average "worst level of pain" score of 4.6 (Table 5). The negative affect score for the midday

affective state survey was correlated with two measures of pain: pain now (0.673; $P < 0.01$), and worst pain (0.572; $P < 0.05$). The hostility score was found to correlate with two measures of pain: pain now (0.728; $P < 0.01$), and worst pain (0.613; $P < 0.05$). The sadness affective score was also correlated with two of the pain measurements: pain now (0.709; $P < 0.01$), and worst pain (0.529; $P < 0.05$).

The final affective state survey was administered on the morning of the third day of walking. In this survey, the average positive affect score for all subjects was 28.26±8.18 and the average negative affect score for all subjects was 15.06±5.31. The average positive and negative affect score for female subjects was 28.1 and 16.8 respectively. While the average of these two scores in the male participants was 28.6 and 11.6 respectively (Table 6). The average "pain right now" value recorded from the Pain Numeric Rating Scale was a value of 3.06, while the average score for "worst level of pain" was 4.6. The score for "usual level of pain" also increased to an average of 2.33 from averages of 0.933 in the afternoon survey, 1.4 in the midday survey, and 1.28 in the preliminary survey (Table 5). For the AM state survey, the negative affective score was correlated with all four pain measurements: pain now (0.725; $P < 0.01$), usual pain (0.554; $P < 0.05$), best pain (0.667; $P < 0.01$), and worst pain (0.639; $P < 0.05$). Both hostility scores and guilt scores were found to correlate with pain now (0.568; $P < 0.05$)(0.699; $P < 0.01$) and worst pain (0.605; $P < 0.05$)(0.575; $P < 0.05$), while sadness affective score was highly correlated with all four pain measurements: pain now (0.754; $P < 0.01$), usual pain (0.744; $P < 0.01$), best pain (0.751; $P < 0.01$), and worst pain (0.750; $P < 0.01$).

The following survey to be administered was delivered during the first of two rest periods, and was designed to assess the trait affective response of the study participants. The average positive and negative affect score for all participants was 31.86±7.24 and 15.8±5.14 respectively.

The average positive and negative affect scores for female subjects was 32.6 and 18.7 respectively, while the average positive and negative affect male scores were 30.4 and 13.2 respectively (Table 6). The average “pain right now” score for all subjects was 1.13, the average score for usual level of pain was 3 and the average score for worst level of pain was 5.33. For this survey, the negative affect score was not correlated with any of the pain measurements, while the hostility affect score was correlated with worst pain (0.685; $P < 0.01$) and the sadness affect score was correlated with usual pain (0.653; $P < 0.01$) and worst pain (0.582; $P < 0.05$). In this survey, the affect score for fatigue was also correlated with two pain measurements: usual pain (0.590; $P < 0.05$) and best pain (0.543; $P < 0.05$).

The second affective trait survey to be administered during the pilgrimage itself was delivered on the final rest day before completion of the Camino. The average positive affect score for all subjects in this survey was 30.4±10.12 while the average negative affect score for all subjects was 15±6.23 The average positive score for males and female subjects was 26.6 and 32.3 respectively, while the average negative affect scores for male and female subjects was 12 and 16.5 respectively (Table 6). The average score for the “pain right now” measurement was 0.8, while the average score for “usual level of pain” was 2.06 and the average worst level of pain score was 3.33 (Table 5). For this survey, negative affect score was correlated to one measurement of pain, pain now (0.550; $P < 0.05$). The score for hostility was not correlated with any of the pain measurements, and the sadness score was correlated with pain now (0.664; $P < 0.01$) and worst pain (0.515; $P < 0.05$). In this survey, usual pain was correlated with the positive affect score (0.522; $P < 0.05$) and joviality (0.530; $P < 0.05$) while the score for surprise was correlated with usual pain (0.677; $P < 0.01$) and worst pain (0.544; $P < 0.05$).

The final survey administered assessed the trait affective response in the subjects in Santiago de Compostela upon completion of the pilgrimage. The average positive score for all subjects was 33.8±8.70 with an average male score of 31.4 and an average female score of 35. The average negative affect score for all subjects was 13.93±4.74, with an average male score of 12.4 and an average female score of 14.7 (Table 6). The average response for “pain right now” was 0.66, the average level of usual pain was 2.4 and the average worst level of pain for this final portion of the Camino was 3.73 (Table 5). For this survey, none of the affective scores, positive or negative, were found to correlate with any of the pain measurement assessment scores.

*Discussion*

The purpose of this study was to determine how pain and affective response relate within subjects undertaking an extended bout of high volume- low intensity exercise. Through a better understanding of how these two factors are related, it is possible to gain a better understanding of the emotional and psychological response experienced by participants and subsequently create exercise prescription methods that more thoroughly enhance performance and adherence. By studying young (Avg. Age = 21.06 yrs) participants who are untrained, this study addresses the issue of exercise motivation and adherence in one of the more critical segments of a population which is currently being devastated by the effects of epidemic rates of obesity and cardiovascular disease although none of the study participants were afflicted by these ailments.

In the initial survey which assessed motivation factors and methods of preparation prior to the Camino, 78% of subjects reported spending at least two hours per week physically training for the pilgrimage, with 35% reporting four or more hours per week of training. The accepted guideline advised by the CDC and other global health organizations is that individuals participate

in at least 150 minutes of moderate exercise per week in order to reduce the risk of cardiovascular disease. The results from this initial survey demonstrate that most of the subjects were near this suggested amount simply in preparing for the Camino, creating the idea that a long term, goal oriented exercise program such as the Camino de Santiago can provide physical and wellness benefits prior to and outside of actual participation in the event. Further studies should investigate exercise habits prior to and post completion of the Camino de Santiago in order to see how these habits may change or adapt before commencing on the Camino and upon its completion and return to a normal livelihood.

While subjects did spend a significant amount of time physically preparing on a weekly basis, 64% of subjects ranked either the emotional pursuit (43%) or the spiritual pursuit (21%) of the Camino de Santiago as the major motivation for participation. Other forms of motivation listed by subjects were a desire for adventure or a new cultural experience. Although only 14% of subjects reported that the physical pursuit of the Camino de Santiago was the primary motivation for participation, 100% believed that they would derive a physical benefit from participation. This information coincides with studies which have reported that intrinsic motives such as those inspired by participation in sport are stronger and more likely to lead to adherence than the extrinsic motivations inspired by exercise alone (Kilpatrick et al, 2005)[51]. The responses of the subjects for this study demonstrate that while the physical toll and benefits of participation in the Camino were a factor in considering participation, it was not the key factor in the motive for participation, and as such it was something which must be conquered and prepared for in order to reach those other motivations and goals.

Each participant certainly dealt with pain and physical duress during the trials of the Camino, but all of the participants were able to complete the pilgrimage and reach Santiago de Compostela,

the final destination for all pilgrims. This fact can testify to the power of a goal oriented exercise program, the strong motivations of the participants and to the added benefit of team based exercise programs. The desire to reach the end of the Camino, and the fact that there was a clearly delineated ending point may have played a large role in participant's maintained enthusiasm and desire to continue through duress. A goal oriented exercise program could be highly effective in other settings and is certainly a strong motivator and powerful tool in the battle to increase exercise participation in the general population.

The motivation of the participants was tested prior to departure for the Camino and yielded results that demonstrated the level of preparation that went into participation, with subjects reporting time spent each week in physical, spiritual and emotional preparation. While most subjects reported that the spiritual aspect of the Camino was the greatest motivating factor for participation, all subjects reported that they expected to receive physical benefits upon completion of the Camino. This once again coincides with the research which states that internal motivators, such as those created by a spiritual desire, are more powerful than external motivators, such as those created by the desire to improve one's aesthetic form. For an exercise program to be effective and adopted by the general population, it should include a way to improve fitness and wellbeing while emphasizing factors that include but go beyond the simple aesthetic consequences of exercise adherence and adoption.

The team based aspect of this pilgrimage may also have played a large role in the success of the participants. The presence of individuals of all abilities and fitness levels meant that it was possible for everyone to find partners and teammates who paralleled their own abilities, and thus could support them, emotionally and physically throughout the Camino. While research has shown that support based exercise regimens can play a positive role in exercise adherence,

there have not been studies in which the support staff and the participants are all undergoing the same exercise program. Such a study could be useful in determining how shared experiences can improve affective response to stressful situation or exercise programs and as a consequence improve adherence and performance.

The trends in the pain measurements and PANAS-X results could also demonstrate some key aspects about the experience of participation in the Camino. The pain measurements trend (Table 1), depicts the expected response of pain measurements increasing throughout the beginning of the Camino and then leveling off or even decreasing towards the end of the Camino as participants became adapted to the physical expectations of the pilgrimage and possibly improved pain tolerance. As expected, the average measurement of “best pain” stayed fairly even throughout the Camino, with only a slight increase from the baseline measurement. This would indicate that while participants were experiencing higher levels of pain on a regular basis, they were not experiencing constant debilitating or overpowering levels of pain. The average measurements for pain now also followed the expected path, the levels of pain increasing throughout the earlier days of the Camino and then decreasing once the subjects had adapted to the exercise. The average measurements for “usual pain” and “worst pain” followed similar paths throughout the pilgrimage, with both peaking in the fifth survey, or on the first rest day. This would indicate that it takes approximately this amount of time for participants to truly adjust to the pilgrimage experience in terms of the physical stress. The study which was performed previously on the Camino would have done well to include blood testing at or just before this stage, because it would seem that it was at this point in the pilgrimage at which subjects were fully adapted.

The trends for positive affect (table 2), negative affect (table 3) and sadness (table 4); also demonstrate important aspects about the affective response of the subjects to the Camino experience. The general trend for the positive affect response shows a large decrease in positive response up until the first rest day, at which point the response began to increase. This would coincide with the pain measurements which seemed to demonstrate that by the time of the first rest day subjects had begun to adapt to the physical stresses of the Camino. The average positive response for female participants was lower in all of the PANAS-X state surveys and then higher for all of the PANAS-X trait surveys. This may be an indication of the differences in pain tolerance and perception in males and females, with females reporting lower positive response to the exercise program up until adaptation at which point they report higher responses on average. It should be noted, however, that the sample size of males was relatively small and thus the data from this sample can only be considered pilot data. The average negative affect trend demonstrated a large spike from the baseline survey to the in situ surveys. At all points the female average negative response was higher than the male average negative response. The strong correlations that sadness showed to pain measurements throughout the Camino constituted the creation of a sadness trend graph. Once again the female average was higher for all measurement points except for the first state survey. This coincides with the results for the average negative affect response.

*Conclusion*

The relationships between affective response and pain perception of a pilgrimage lasting 30 days and covering 758 kilometers were tested in this study. Previous studies have shown that the pilgrimage is performed at a moderate intensity, representing approximately 55% of maximum heart rate and as such fulfills the requirements for physical activity put forth by

multiple international health entities. The motivational influences and preparatory commitments that subjects had prior to participation in the Camino were also investigated. An understanding of the motivation, affective response, and pain perception during an extended exercise bout such as the Camino de Santiago can help broaden the understanding of all of the psychological components that play a role in exercise participation and adherence and eventually lead to the physiological improvements that are so often investigated and cited in association with exercise. From the results of this study, it would seem that the best way to promote adherence would be to reduce pain which in turn would reduce negative affective response. This could be accomplished by allowing periods of approximately 2 weeks for acclimation to occur before increasing the volume or duration of prescribed exercise bouts.

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Table 1

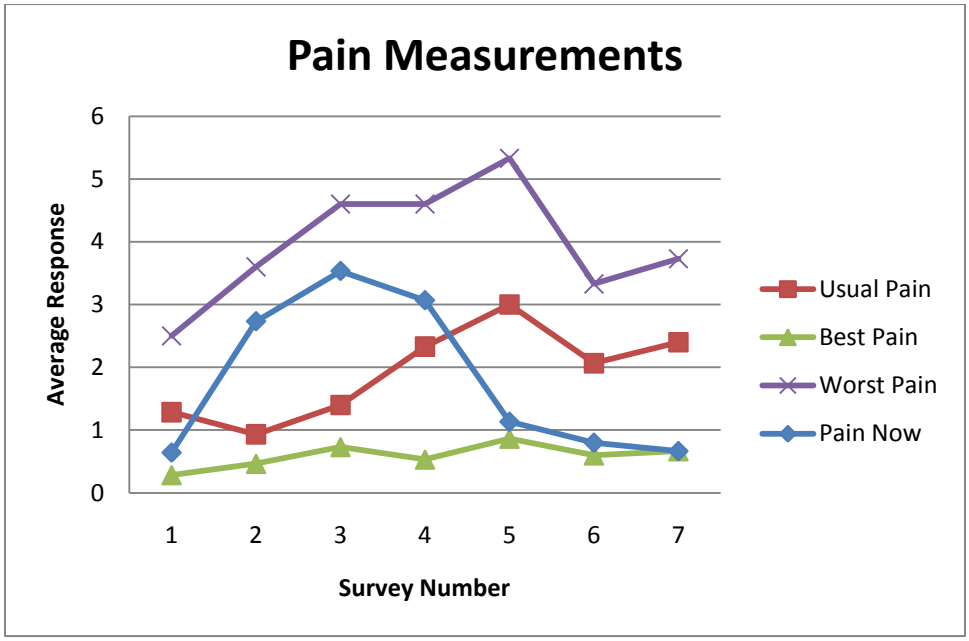

Pain Measurements
Average Response
0
1
2
3
4
5
6
1
2
3
4
5
6
7
Survey Number
Usual Pain
Best Pain
Worst Pain
Pain Now

Table 2

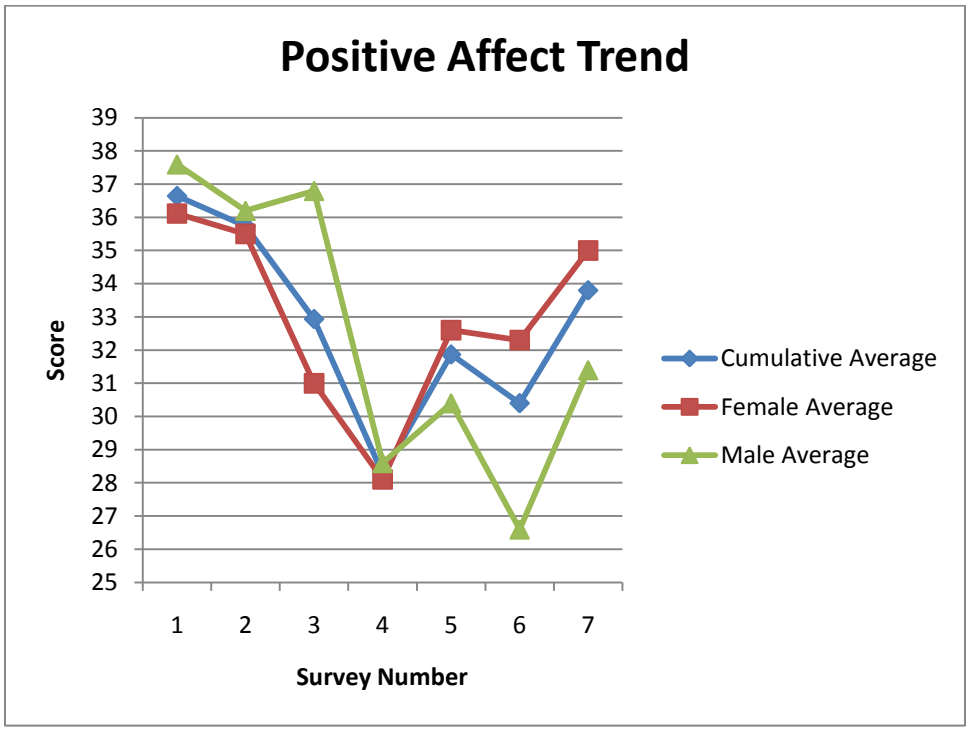

Positive Affect Trend
Score
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
1
2
3
4
5
6
7
Survey Number
Cumulative Average
Female Average
Male Average

Table 3

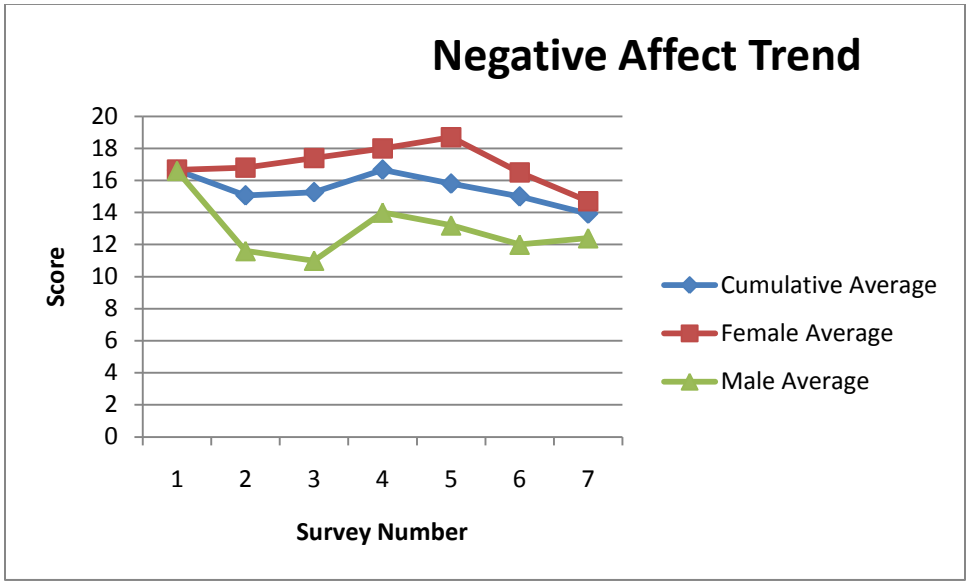

Negative Affect Trend
Score
20
18
16
14
12
10
8
6
4
2
0
1
2
3
4
5
6
7
Survey Number
Cumulative Average
Female Average
Male Average

Table 4

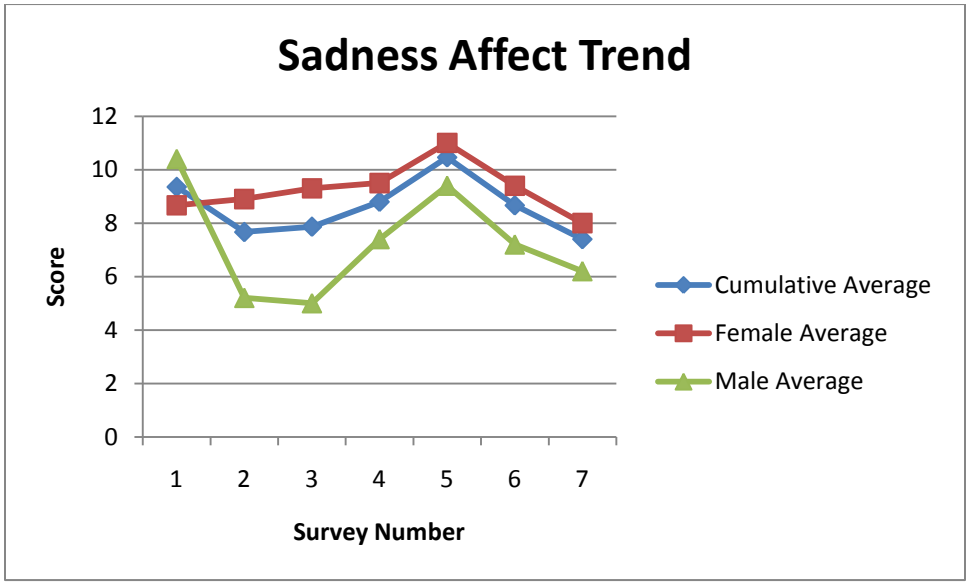

Sadness Affect Trend
12
10
8
6
4
2
0
Score
1
2
3
4
5
6
7
Survey Number
Cumulative Average
Female Average
Male Average

Table 5

Pain Score Averages

| | Survey 1 | Survey 2 | Survey 3 | Survey 4 | Survey 5 | Survey 6 | Survey 7 |
|---|---|---|---|---|---|---|---|
| Pain right now | 0.642857 | 3.066667 | 3.533 | 2.733 | 1.133 | 0.8 | 0.666 |
| Usual Pain | 1.2857 | 2.33 | 1.4 | 0.933 | 3 | 2.066 | 2.4 |
| Best Pain | 0.2857 | 0.533 | 0.733 | 0.466 | 0.866 | 0.6 | 0.666 |
| Worst Pain | 2.5 | 4.6 | 4.6 | 3.6 | 5.33 | 3.33 | 3.73 |

Table 6

Average PANAS-X Scores

| | Survey 1 | Survey 2 | Survey 3 | Survey 4 | Survey 5 | Survey 6 | Survey 7 |
|---|---|---|---|---|---|---|---|
| Positive | 36.64286 | 35.73333 | 32.93333 | 28.26667 | 31.86667 | 30.4 | 33.8 |
| Negative | 16.64286 | 16.66667 | 15.26667 | 15.06667 | 15.8 | 15 | 13.93333 |
| Sadness | 9.357143 | 8.8 | 7.866667 | 7.666667 | 10.46667 | 8.666667 | 7.4 |
| Hostility | 9.214286 | 8.733333 | 8.466667 | 8.333333 | 9.933333 | 8.266667 | 7.2 |
| Guilt | 9.785714 | 7.933333 | 8.2 | 7.466667 | 9.133333 | 8.133333 | 7.2 |

*Appendix 1*

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Use the following scale to record your answers:

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Very Slight or not at all | A little | moderately | Quite a bit | extremely |

Thinking about yourself and how you normally feel, to what extent do you generally feel:

- [ ] cheerful [0]
- disgusted
- [0] attentive [0]
- bashful
- [0] sluggish [0]
- daring
- [ ] surprised [0]
- strong
- [0] scornful [0]
- relaxed
- [0] irritable [0]
- delighted
- [0] inspired [0]
- fearless
- [0] disgusted with self [0] sad
- [0] calm [0]
- afraid
- [0] tired [0]
- amazed
- [0] shaky [0]
- happy
- [0] timid [0]
- alone
- [0] alert [0]
- upset
- [0] angry [0] bold
- [0] blue [0] shy

- [ ] active [0]
  guilty
- [0] joyful [0]
  nervous
- [0] lonely [0]
  sleepy
- [0] excited [0]
  hostile
- [0] proud [0]
  jittery
- [0] lively [0]
  ashamed
- [0] at ease [0]
  scared
- [0] drowsy [0] angry
  at self
- [0] enthusiastic [0]
  downhearted
- [0] sheepish [0]
  distressed
- [0] blameworthy [0]
  determined
- [0] frightened [0]
  astonished
- [0] interested [0]
  loathing
- [0] confident [0]
  energetic
- [0] concentrating [0]
  dissatisfied with self

*Appendix 2*

Pain Numeric Rating Scale

1. On a scale of 0 to 10, with 0 being no pain at all and 10 being the worst pain imaginable, how would you rate your pain RIGHT NOW.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No Pain | | | | | | | | | | Worst pain Imaginable |

2. On the same scale, how would you rate your USUAL level of pain during the last week?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No Pain | | | | | | | | | | Worst pain Imaginable |

3. On the same scale, how would you rate your BEST level of pain during the last week?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No Pain | | | | | | | | | | Worst pain Imaginable |

4. On the same scale, how would you rate your WORST level of pain during the last week?

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| No Pain | | | | | | | | | | Worst pain Imaginable |

*Appendix 3*

What is your name:

What is your student identification number?

Please respond to the following:

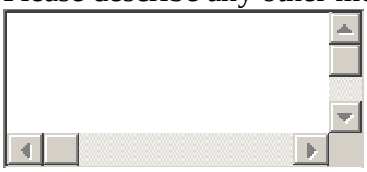
Please Respond to the following:

| | 1Strongly Agree | 2 Agree | 3 Neutral | 4 Disagree | 5 Strongly Disagree |
|---|---|---|---|---|---|
| **My motivation for participating in the Camino is a physical pursuit.** | ○ | ◉ | ○ | ○ | ○ |
| **I spent time in physical training to prepare for the camino.** | ○ | ○ | ○ | ○ | ○ |
| **I expect to receive physical rewards/benefits from participating in the Camino** | ○ | ○ | ○ | ○ | ○ |
| **My motivation for participating in the Camino is a spiritual pursuit.** | ○ | ○ | ○ | ○ | ○ |
| **I spent time in spiritual training to prepare for the Camino.** | ○ | ○ | ○ | ○ | ○ |
| **I expect to receive spiritual rewards/benefits from participating in the Camino.** | ○ | ○ | ○ | ○ | ○ |
| **My motivation for participating in the Camino is an emotional pursuit.** | ○ | ○ | ○ | ○ | ○ |
| **I spent time in emotional training to prepare for the Camino.** | ○ | ○ | ○ | ○ | ○ |
| **I expect to receive emotional rewards/benefits** | ○ | ○ | ○ | ○ | ○ |

Please Respond to the following:

| | 1Strongly Agree | 2 Agree | 3 Neutral | 4 Disagree | 5 Strongly Disagree |
|---|---|---|---|---|---|
| **from participating in the Camino.** | | | | | |

Please describe any other motivation for participating in the Camino below:



Please rank the following motivations for participating in the Camino, with 1 being the greatest. Only rank those choices that apply to you:

- ☐ Physical pursuit
- ☐ Spiritual Pursuit
- ☐ Emotional Pursuit
- ☐ Other (please state) ☐
- ☐ Other (please state) ☐

Approximately how much time per week did you spend physically preparing?

0 hours 1-2 hours 2-4 hours 4-6 hours 6-8 hours 8+ hours

○ ○ ○ ○ ○ ○

Approximately how much time per week did you spend spiritually preparing?

0 hours 1-2 hours 2-4 hours 4-6 hours 6-8 hours 8+ hours

○ ○ ○ ○ ○ ○

Approximately how much time per week did you spend emotionally preparing?

0 hours 1-2 hours 2-4 hours 4-6 hours 6-8 hours 8+ hours

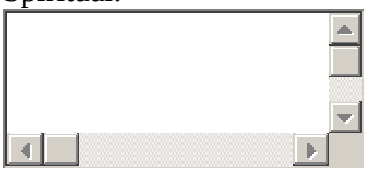
○ ○ ○ ○ ○ ○

Please describe the method of preparation. State 'not applicable' if you did not do any type of preparation for an area listed below:

Physical:

Emotional:

Spiritual:



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