Introduction

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Brazilian soccer legend Pele once confided in a reporter that while playing he felt a strange calmness, "It was a type of euphoria." he said. "I felt I could run all day without tiring, that I could dribble through any of their team or all of them, that I could almost pass through them physically. I felt I could not be hurt. Perhaps it was merely confidence but I have felt confident many times without feeling that strange invincibility." Similarly, John Brodie, a former quarterback for the San Francisco forty-niners, wrote that during a game, "time seems to slow way down, in an uncanny way, as if everyone was moving in slow motion. It seems as if I have all the time in the world to watch the receivers run their patterns, and yet I know the defensive line is coming at me as fast as ever."

Runner's high, second wind, dissociation; the effects of exercise on stress have slowly become known to popular culture and taken on names of their own. Whatever you call it, it is a phenomenon that the average person knows little about and which continues to puzzle the scientific community. We chose to research exercise and the way it affects stress because personally, we are both athletes, and certainly we are both stressed. With all the added stress we were under holding down jobs, playing a sport, and taking all the AP classes we were, we began to wonder what made a person better able to handle stress. Everyday we see classmates that seem to have half the responsibilities we do, frazzled out of their mind by their stress. However, we also see other students who are carrying course loads we think are impossible and still never seem stressed out. We decided to research this in the hopes that we could find better ways of coping with our own personal stress.

Before we pose our broader question, however, we must first define our terms. There is no simple definition for stress, but for the sake of this project and in general, stress can be thought of as "the perception that events or circumstances have challenged or exceeded a person's ability to cope." (Constable, p. 5) For these very reasons, the study of stress is often difficult because it is so subjective. Stress affects everyone differently, some individuals crack, some simply cope, and some are inspired to rise above the challenge. What enables a person to handle stress better than the next person? Is it hereditary, or acquired? If it is acquired what life patterns or activities help a stressed individual acquire the characteristics needed for effective stress relief? Can a stressed person become unstressed, and vice versa? We hope to answer these questions through our project and maybe find a better way to rid ourselves of the weight on our shoulders, the burden we bear, that little thing that plays such an unwanted role in everyone's life : stress.

In beginning our research on stress, we found that "…taking frequent effective exercise is probably one of the best physical stress-reduction techniques available. Exercise not only improves your health and reduces stress caused by unfitness, it also relaxes tense muscles and helps you to sleep." (Earthnet) It improves blood flow to your brain, bringing additional sugars and oxygen, which may be needed when you are thinking intensely. When you think hard, the neurons of your brain are forced to function more effectively in less time. As they do this they build up toxic waste products that cause foggy thinking in the short term, and can damage the brain in the long term. During exercise, the flow of blood to the brain is increased, moving these waste products faster. Exercise also improves blood flow so that even when you are not physically exerting yourself, waste is eliminated more efficiently. Your body temperature rises, adrenal activity is increased, and your nuerotransmitters function more efficiently. But perhaps most importantly, exercise releases chemicals into the blood stream called endorphins. Endorphins (literally, morphine within) were a long time in the discovering. It had long been suspected in the scientific community that there were specific binding sites in the brain for opiates. Once these were found in the 1970s, it raised the question of "Why would God have made opiate receptors unless he had also made an endogenous morphine-like substance?" (Goldstein, Lowney & Pal, 1971) Later, in 1975, two doctors in Scotland discovered endorphins. It was found that they interacted with specific opiate receptors in the brain to reduce the sensation of pain. Beta-endorphins, found mainly in the pituitary gland, and enkephalins and dynorphins, circulated through the nervous system, are the three main types of endorphins. "Prolonged, continuous exercise contributes to an increased production and release of endorphins, resulting in a sense of euphoria that has been popularly labeled runner's high." (Britannica, 2001)

Some say exercise only takes one's mind off stress, and therein lie the benefits, but there is mounting evidence that the physical and emotional condition is impacted for the better during exercise through the release of endorphins. A study done by Dr. Landers and Boutcher Ph.D. (Diamond, p. 264) considered the effect of vigorous exercise and then the effects of a quiet reading session on the same individuals. They found that almost without fail the subjects felt much less anxiety after running, whereas their anxiety decreased only slightly after reading. Their results join in the many others that point to the conclusion that exercise is not only physically but also emotionally healthy for the participants.

When approaching exercise as a relief mechanism for stress however, we must look at the way in which an individual exercises. We propose that the ability to handle stress is an acquired characteristic, gained through exercise and specifically competitive sports where high stress environments are present. For the sake of the experiment, sports that are played for our highschool and will be deemed high physical stress sports are: basketball, football, baseball, softball, lacrosse, tennis, track and field, soccer, swimming, and diving. Each of these has the crucial element of competition. Non competitive exercisers will be deemed anyone who strenuously exercises 3 or more times a week, with strenuously defined as 20 minutes of exercise in which the participant reaches peak heart rate.

We also wish to study the effect of the 'quick fix' stress relievers such as alcohol, cigarettes, and drugs on athletic and non athletic individuals. "Scientists have found that smoking cigarettes is in many ways a 'coping response' to the stress of daily living." (Diamond, p. 227) However, quitting smoking is incredibly stressful for two reasons: a. the nicotine withdrawls, and b. the lost of a coping mechanism. While initially smoking will decrease stress levels in one's life, scientists have found that the mounting addiction begins to add to the stress in one's life. (Diamond, p. 228) Trying to quit smoking is one of the most stressful events in a smoker's life, and the last thing that an already stressed out individual needs is an addiction to nicotine. Even if the smoker is not attempting to quit, scientists are adding more and more diseases and disorders to the list of smoking's effects every year. In addition, as tolerance increases, the quick fix is no longer so easy to attain. Added to the social pressures now put on smokers, what was once a coping mechanism is now a source of stress in itself. Since we assume that athletes smoke less than non athletes, we believe that this is a secondary benefit reaped from the athletic lifestyle.

The stress reducing effects of alcohol are much more dubious. Since people consume alcohol for the very purpose of reducing stress, a placebo effect is introduced. "In a study of the stress reducing effects of alcohol, one group was given two drinks of vodka, while the second group was given an equal amount of tonic water and vitamin C. Half of the subjects in each group were told that they were given alcohol, and the other half were told they were given vitamin C. Those who thought they consumed alcohol, whether they did or did not, reported greater mood elevation than those who thought they consumed Vitamin C." (Charlesworth, p. 203) We believe that alcohol consumption amongst athletes is less than the alcohol consumption of the average teenager. We wish to study through our survey the added stress of drinking illegally as a teenager between athletes and non athletes. If our assumptions are correct, then competitive athletes will not only have less stress because of their exertions but also because of the potential stressors like alcohol and cigarette that they are forced to usually avoid.

Nutrition is another key factor to stress relief. It is assumed that athletes and exercisers both get reasonably good diets, whereas a non-athletic individuals have diets that would probably be all over the scale of nutrition. For those with weight problems, there can be a cycle of stressful situation leading to overeating which leads to weight gain, which then leads to another stressful situation. (Diamond, 143) In most cases, the original stressor also exists, so the overeating solved nothing. While this may not be the case with most non-exercisers and non-athletes, the lack of three healthy, nutritious meals a day can lead to physical wear down.. Since exercise intensity, habits, and nutrition will presumably be close to the same between the athletes and exercisers, the only variable is the presence of competition in their workouts. The control group in our survey is the non-exercisers, non-athletic individuals. Since they neither play a sport nor exercise on their own time, they provide a baseline from which to base our results.

Our final point of study is the difference between types of exercise. Forms of exercise vary drastically from yoga, to walking, to jogging, to simple cardio vascular activity, to competitive sports. Is there a difference between competitive and non competitive exercisers? Does a background in competitive sports help an individual learn to cope with daily stress better than an individual that simply exercises but does not play a competitive sport? Certainly one faces immense amounts of physical stress in a competitive sport while simultaneously working out the day's stress through athletic activity. The temporary stress in competitive sports is often more of the primal kind, where the vestigal fight or flight reaction is actually beneficial. When stress is introduced to an individual, the fight or flight response is triggered. "When you are under stress, your brain sends messages out to the rest of your body through a part of your autonomic nervous system called the sympathetic nervous system, which causes the release of hormones called epinephrine and norepinephrine (also known as adrenaline and noradrenaline). As a result, your heart rate and breathing rate increase, your blood pressure rises, your muscles tense and your metabolism increases. This response is called the fight or flight response because it prepares you to fight back or run away in a threatening situation." (Mind Tools, 1995) Unfortunately, running away from or beating the tar out of a stressor is usually not a viable solution in today's world. Competitive sports however, often give a release for this response, allowing the chemicals of epinephrine and norepinephrine to serve their purpose and then leave the body. Emotional stress alone gives you only the epinephrine and does not give release to the chemicals. After prolonged exposure, this process becomes harmful if the individual has no outlet for the response.

For example, many people are caused stress by airplanes, but the fight or flight response (no pun intended) is useless because the individual is trapped on an airplane with no outlet. The same hormones are released and your body undergoes the same reaction to two very different kinds of stress, physical and emotional. Physical stress usually provides an outlet (lifting up cars to save an injure person, competitive sports, etc) whereas emotional stress leaves the individual in the same state of alert with nothing to do. If emotional stress finds no outlet, it will lead to certain kinds of physical stress. If exposed to emotional stress over a prolonged period of time, the chemicals accumulate in the blood stream and cause several harmful effects. For example, when norepinephrine and epinephrine are present in large amounts, the immune system is inhibited and the T cells cannot function appropriately, leading to a stressed individual getting sicker often and for longer periods of time. This perpetuates the cycle of stress in an individual, where (after prolonged) emotional stresses leads to physical stress and often back to emotional again.

In addition, the life and organizational patterns learned from participating in a competitive sport, we believe, will help the participant deal with everyday stressors better than the average person. While it would seem that playing a competitive sport would increase the amount of stress in an athlete's life, it also teaches by necessity the ways to deal with that stress. We believe, on average, athletes usually have better nutritional habits than non-athletes. They are forced to use better time management skills or face problems in the sport or school. They smoke, drink, and engage in illegal drug use less than the average individual. We believe that the secondary benefits garnered from an athletic lifestyle will help an athlete deal with stress better if only because they are not engaging in stressful activities.

Competition, in itself, is a complicated thing. It can even be harmful when practiced continually in everyday life. From the economics of Dr. John Nash to the specific studies of Dr. Robert Helmreich (tested schoolchildren in cooperative vs. competitive environments) it has been found that competition is not always beneficial. (Lewis, 173) We wish to study the effects of competition in a strictly physical sense, however, to see if the stress reduction is comparable to non competitive exercise.

The focus of our research, however, is whether the group of competitive athletes or the exercisers will have less stress in their lives. When researching the benefits of exercise on stress, the local library had very little information of which types of exercise were more beneficial. We found almost no medical journals or magazine articles on the subject. Since exercise is such a broad term, and used so vaguely, we decided to focus on two different types of exercise, competitive sports and non competitive cardio vascular exercise (jogging on a treadmill, stairmaster, elliptical trainers, etc.) By focusing on these two, we will isolate our variable of competition.

Our question is this:

Does competitive exercise and the habits learned thereof provide the individual with better mechanisms of stress relief than non-competitive exercise?