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Magnet Therapy

An Interactive Qualifying Project Report
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Abstract

Magnet therapy, the placement of permanent magnets on or near injured areas of the body, is an ancient form of treatment. Within the last decade, this alternative practice has become increasingly popular as well as profitable for many companies. The goal of this project is to demonstrate this renewed growth, via an analysis of public perception, and industry practices and regulations. Available scientific evidence will also be reviewed and a comparison of significant medical studies will be made to determine the extent to which scientists have researched the validity of magnet therapy.

Acknowledgements

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Chapter 1: Introduction

1.1 Introduction

Magnet therapy, the placement of static field magnetic materials on or near injured or painful areas of the body, is a health practice that has been used for several thousand years. For most of this time, western society has laughed at magnet therapy, calling it 'quackery.' However, the past several years have seen an enormous increase in the popularity of magnet therapy. New websites are popping up each day for companies selling magnetic goods, while professional athletes publicly praise the healing effects of magnet therapy. Despite the fact that there are no physical explanations or conclusive medical studies, people are giving new life to this ancient form of treatment. With the increasing mass acceptance of many holistic medicinal practices such as acupuncture, the American people may be open to alternative cures, now more than ever. Magnet therapy is becoming a major business in the United States having an economic, medical, and social impact on the entire country.

1.2 Objectives

The main objective of this IQP is to study the current status of magnet therapy in the scientific community and in society. One of the key features of this is to examine the type of people purchasing these magnet therapy devices. Are these people educated, elderly, rich, or spiritual and open to alternative therapy? The way in which the magnet therapy industry markets its products will also be studied to determine what group of people are targeted to buy the products. To determine the market segment for magnet therapy, the various advertisements in magazines,

newspapers, internet websites, television commercials, and infomercials will be considered. Two more trends demonstrating the growing popularity of magnet therapy are the increasing profit by the magnet therapy industry as well as the industry growth from only several years ago.

The technical side of magnet therapy will be examined; in this case, the United States Food and Drug Administration (FDA) approval and medical studies into magnet therapy. Organizations, such as the National Institutes of Health (NIH) and medical researchers test the validity of the magnet therapy industry's claims and will directly affect magnet therapy's popularity and profits. A variety of medical studies concerned with the effects of magnet therapy will be analyzed, concluding with a comparison between the most documented and the most recent study. A final aspect of this project would be to compare the popularity of magnet therapy to that of another alternative therapy, acupuncture, which has gained mass acceptance in the last ten years.

1.3 Methodology

Several surveys will be performed to determine public opinion about magnet therapy. Also, medical studies and physical explanations as to the functioning of magnet therapy devices will be analyzed. Various businesses that sell therapeutic magnets will be contacted in order to get a clearer view of their own customer focus groups and how and where they advertise their products. Here is an outline form of the methodology that will be applied to this project.

- WPI mail survey and shopping mall survey will be conducted to find what types of people buy, believe, and use magnet therapy.

- Contact magnet therapy industry and research important industry numbers such as industry growth and sales.

- Find, analyze, and compare medical studies and physical explanations of magnet therapy.

- The FDA and NIH will be contacted to determine the extent of magnet therapy regulation and funding and information concerning current medical studies.

- Examine the publicity of magnet therapy: the advertisements in magazines, web sites, and on television as well as magazine and newspaper articles to determine the type of people targeted by the magnet therapy industry.

- Research and compare magnet therapy to more accepted forms of holistic medicine.

Chapter 2: Background

2.1 History of Magnet Therapy

Magnet therapy has been used by human civilization for more than 4000 years. The earliest evidence of this has been found in ancient Chinese writings dating back to around 2,500 BC (Hutchins, 1955). Over the last 4000 years, the use of magnet therapy has been determined by several distinct factors. These factors include the time period in which the magnets were used, which cultures used magnet therapy, and the social, governmental, and religious views on magnet therapy. With these factors in mind, it is possible to see why the acceptance of magnet therapy has flourished in areas of the world such as Asia and why it also has been a slow moving progression in countries such as the United States as well as countries in Europe.

It is not known when Asian and other oriental countries discovered magnets, or when the population started to use them in conjunction with their daily lives. The first known written paper can be found in the Yellow Emperor's Book of Internal Medicine (Hutchins, 1955). It has been estimated that this book was written between the years of 2600 BC and 2500 BC (Hutchins, 1955). The material in this book is still being used to this date. The duplication of this book, along with the expansion of Buddhism, spread the concept of magnet therapy.

To understand why the ancient oriental people thought magnet therapy relieved pain, it is first necessary to understand their view on the human body. For the last several thousand years, oriental people have made the correlation that the internal energies, qi (also called ch'i or chi), affect people's lives. They believed this qi came from two opposing influences or poles, yin and yang, and that illness results when the

two forces are out of balance (Whitaker, 1998). They believed that the placement of magnets in certain position on the body would cause the energies to once again attain equilibrium. Figure 2.1 illustrates the specific points for the placement of magnets (Gilbert, 1958).

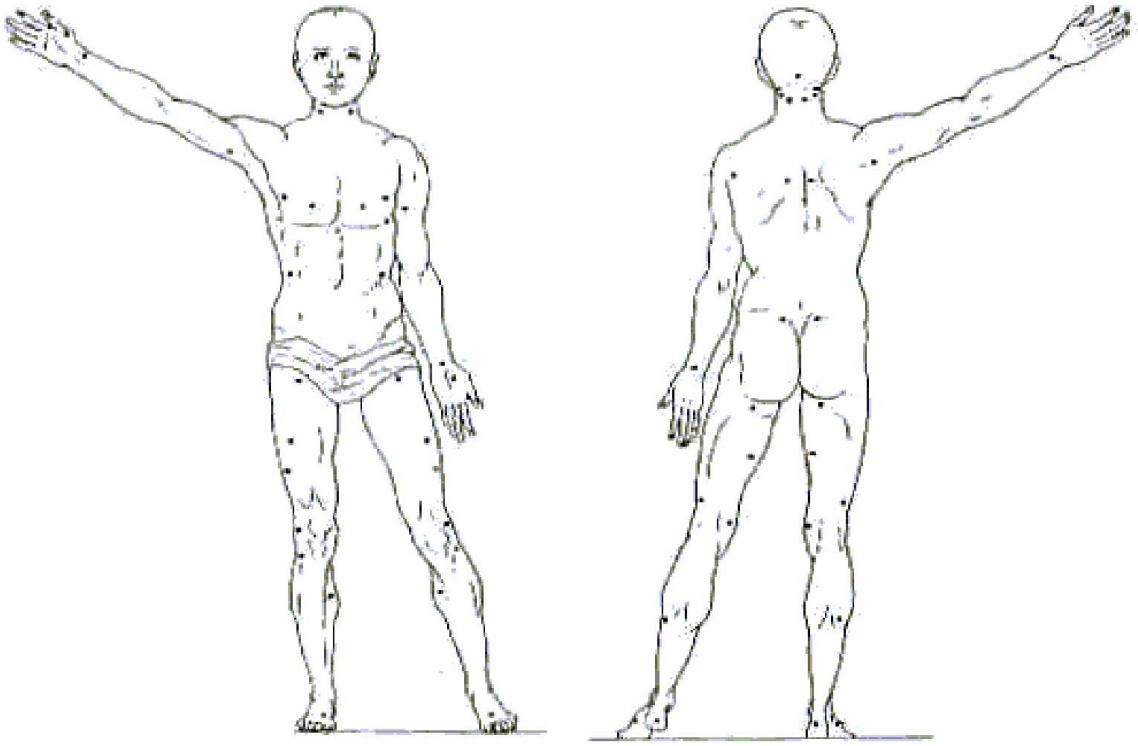


Figure 2.1: Diagram showing the correct placement of magnets.

The black dots on the body indicate where magnets should be placed in order to balance one's internal energies. Based on a person's symptoms, magnets were placed at strategic points on the body that would correspond to the ailment. An example being that if a person was having problems with arthritis in their knees, magnets should be placed above, below, and around the knees.

The Egyptians used magnet therapy, but what they used it for and how they used it is very limited in detail. What is known, however, is that the Egyptians made

trade routes to Ethiopia in order to obtain magnetic stones for the royalty and elite of Egypt (www.homewatermagnet.com). It has been stated in several sources that Queen Cleopatra wore a magnet on her forehead, while she slept, to prevent aging (Whitaker, 1998). Little is known about the other uses of magnet therapy because most of the knowledge was only passed on by word of mouth and not committed to written text.

Due to the migration of people from western Asia to Europe and the expansion of the Greek and Roman Empire, magnet therapy has been in parts of Europe for the last 3000 to 2500 years. This knowledge of the use of magnets for medicinal purposes was passed from the oriental countries to countries located around the Mediterranean Sea. Magnet therapy was known in India, China, Egypt and other countries hundred of years before the Greek or Roman empires had even begun to develop (Hutchins, 1955).

The word magnet comes from the Romans, who found a large deposit of magnetic material in Magnesia, a location in Asia Minor (Adderly, 1998; Macklis, 1993). Figure 2.2 shows the location of where the Romans obtained large amount of magnets for their use (Adderly, 1998).

Once the Roman and Greek empires acquired the knowledge of magnet therapy around 100 BC, through conquering foreign lands and exploiting their knowledge, they started to use magnet therapy in their daily lives. The major acknowledgement of magnet therapy and its uses can be found in the writings of Plato, Euripides, and several other Greek and Roman authors (http://www.dcn.davis.ca.us/~btcarrol). Many of the Roman Empire scholars thought that magnet therapy was necessary to live, grow, and prosper. It was stated in many

Roman texts that magnet therapy was a cure for constipation and other stomach pains (Gilbert, 1958).

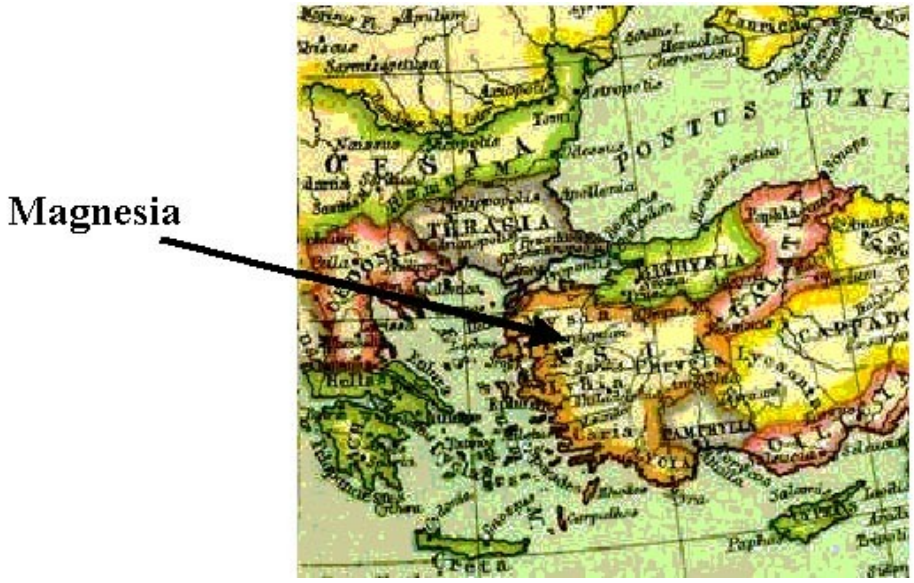


Figure 2.2: The location of large deposits of magnetic material.

Throughout the Dark Ages in Europe, there was little written about the use of magnet therapy. After the Roman Empire fell, the knowledge of magnet therapy was kept secret by the religious leaders and the royalty of the countries around the Mediterranean Sea and in Europe. During these centuries, people forgot the previous uses of magnet therapy developed by the Greek and Roman Empires. However, China and other oriental countries continued to practice magnet therapy with enthusiasm.

After the period of the Dark Ages, William Gilbert was the first to rediscover the idea of magnet therapy. Before his book, De Magnet, was published, he spent almost 20 years researching the topic of magnet therapy. While doing this, he obtained the position of Royal Physician and was faced with the task of trying to save

Queen Elizabeth from an illness (Hutchins, 1955). He used magnets to try to heal, or at least reduce, the pain that she was experiencing as a result of her illness. Gilbert also found that magnetic powders and ointments did not have sufficient magnetic strength as compared to the large natural magnetic stones. The use of these topical treatments, he concluded, did not have any effect (Lawrence, 1998).

In the late 18th Century, Franz Anton Mesmer "both vaulted magnet therapy into the public limelight and turned it into a sideshow" (Whitaker, 1998). He produced such things as magnetized water and other magnetized objects and issued reports, such as the 1775 report *On the Medical Uses of the Magnet*. Mesmer claimed that he could restore hearing to the deaf and sight to the blind with the use of magnet therapy. Mesmer opened healing salons in Paris where patients were immersed in magnetized water near protruding iron rods and they would then awake in 'hysterical fits', claiming to be cured (Whitaker, 1998). French physicians considered Mesmer's practices to be fraudulent and believed that there were no benefits in using his products.

In 1784, the French Academy of Science convinced King Louis XVI to establish an unbiased royal commission to determine whether the use of magnetized devices was fraudulent or not. The commission was composed of four people: an astronomer Jean-Sylvian Bailly, who determined the orbit of Halley's Comet, Antoine Lavoisier, a chemist, who demonstrated the role of oxygen in respiration and fire, Benjamin Franklin, a scientist and the American ambassador to France, and Dr. J. I. Guillotin, today remembered for his decapitation device. After observing patients who had used and were using magnet therapy, the commission concluded that "magnetic

healing was the result of the patient's belief in it and of the influence of imagination, suggestion, and imitation" (Whitaker, 1998).

Then, during the mid-1800's, physicists began to learn and understand the relationship between a moving current of electricity and how it relates to magnets. First, around 1820, Ampere described mathematically the interactions between magnetic forces and electrical conductors. Then, in the 1830s Michael Faraday made his revolutionary discovery that a moving magnetic field induced an electric current in a coil of wire. Following this discovery, around 1860, James Maxwell was able to describe in mathematical terms the elegant similarities between electricity and magnetism and how the movement of one would create the other. Even with these newly developed ways of describing magnetism, people in Europe continued to feel that magnet therapy was merely a fraud.

In the United States, during the end of the nineteenth century, there were a few people who still believed that magnets had the ability to heal and continued to buy products that were related to this form of controversial therapy. However, when the industrial age of the Untied States started to develop, magnet therapy once again began to disappear. Magnet therapy lost all credibility when, in the 1940's, several events occurred to finally make alternative medicines non-reliable treatments in relieving pain and curing diseases. The first event occurred when President Franklin D. Roosevelt established the Food and Drug Administration (Lawrence, 1998). In doing this, it now became necessary to provide substantial proof for claims made about some type of cure. Then, the American Medical Association became a determining factor in the way in which people were being accredited as professional

doctors. Also, with the development and usage of antibiotics, many people wanted to rely on something that had definite visual signs of improvement instead of a product that supposedly worked.

Magnet therapy, while having a long and extensive history, has not been reported in specific detail. This is due to the fact that the royalty and the elite of certain societies were the only people to use magnet therapy and felt they should be the only ones to be able to practice this therapy. Over time, more research on the use of magnet therapy may prove or disprove the abilities of this therapy, but at this time there is much doubt about its claims.

2.2 Magnet Therapy Today

Today, magnet therapy is a booming industry whose product is available in a variety of locations, from the internet to local pharmacies. Advertisements and commercials can be found on television, in newspapers, and in magazines, all promoting the healing effects of magnet therapy. These advertisements describe the wide variety of magnet therapy products currently available and inform consumers of their relatively low cost. In addition, many books are widely available praising magnet therapy. The books that were reviewed by this IQP group, describe patient's success stories, the possible workings of magnet therapy, and step by step guides on how to use magnet therapy products. These advertisements and books use patient's success stories in order to promote magnet therapy, and even use celebrity endorsements to convince people of the validity of magnet therapy. In many cases,

professional athletes who have had personal success with magnet therapy become spokesmen for a particular product or tell of their success stories in books. Increased promotion of magnet therapy is leading to a rejuvenation of this ancient medical practice, and a variety of ways to purchase the product.

Many different magnet therapy products are currently available over the internet, on television, in local stores, and in catalogs. Products advertised to heal various parts of the human body as well as jewelry and even mattress pads are sold to thousands of Americans and other people around the world every year. The cost of these devices is mainly dependent on the number of magnets contained in the device and the strength of their magnetic field. While all companies list the prices of the products and what they supposedly cure, only several companies list the number of magnets in the product or their field strengths. Below is a table sampling the common commercially sold magnet therapy products, their prices, and the number and strength of the magnets within them. The magnetic field strengths of these magnetic devices are seen as very high when compared to the strength of the earth's magnetic field of 0.5 G.

The following sources were used to compile the table below: americanmagnet.com, magnethealththerapy.com, bmi-magnetics.com, health-magnets.com, discovermagnetics.com, and equinemagnetics.com.

Products	Number of Magnets	Magnetic Field per Magnet(G)	Price ($)
Back Belt	32	3850	60-80
Shoe Insoles	1-8	800-2300	10-25
Elbow Wrap	18	1000-3850	15-25
Wrist Wrap	4	2500	15-20
Knee Wrap	16	2000	20-25
Bracelet	2	2500	10-15
Shoulder Pad	15	1000	20
Mattress Pad	125-400	800-1500	170-450
Pillow Pad	13	800	29
Eye Mask	8	800	25
Hairbrush	1	1000	10
Horse Blanket	140	--	500
Horse Leg Wraps	12	--	110

Many of the books and literature currently available to consumers promote magnet therapy and therefore educate the public, thus benefiting the magnet therapy industry. Several books currently sold in stores, such as The Pain Relief Breakthrough, Magnet Therapy: Balancing Your Body's Energy Flow for Self-Healing, Magnet Therapy, and Healing With Magnets, all praise magnet therapy and educate readers on how to take advantage of this practice. These books all begin with an explanation of magnetism and a brief history of magnet therapy. They also instruct the reader on how magnet therapy works, sometimes saying they are not exactly sure, but mainly explaining how magnet therapy can block pain or increase blood flow. Many of the books also say that much further study is needed to learn the full curative effects of magnet therapy. Diagrams are provided along with the text to instruct the

reader as to the proper placement of the magnets for effective treatment of a variety of ailments. The list of ailments that the books claim are treatable with magnets is quite extensive. They range anywhere from arthritis and body pain to stress and depression to even cancer and heart disease. Personal success stories of patients and even doctors are used as evidence to support the use and sale of magnet therapy products. Several of the books reviewed were written by medical doctors, but in all cases, these books were written by people who have had success with magnet therapy.

Many companies are also using personal success stories in advertisements, commercials, and even the internet, to convince consumers to purchase their products. Although the statements of average people are sometimes convincing, these companies now have celebrities and sports professionals endorsing and selling their products. Many professional athletes from golfers to football players are using magnet therapy to treat the pain that accompanies their profession. Jim Colbert, was on the verge of giving up tournament golf due to lower-back pain, but because of the curative effects of magnet therapy, he was able to continue with the sport and has gone on to win such awards as Senior PGA Tour player-of-the-year (Barkow, 1998). Many senior golf professionals now endorse magnet therapy products that allow them to continue playing, from John Huston and Chi Chi Rodriguez, to LPGA players such as Donna Andrews.

Many football players also use magnet therapy to alleviate the pain and injuries that accompany their profession. Denver Broncos linebacker Bill Romanowski uses magnetic mattress pads to promote healing (Lawrence, 1998). Ryan Vermillion, head trainer of the Miami Dolphins, uses magnet therapy to treat his players both on and off

the field. Magnet therapy products were also used on quarterback Dan Marino to heal a broken ankle in half the time doctors had predicted (Lawrence, 1998). The players of the Miami Dolphins have been so convinced of the healing qualities of magnets that they have begun to endorse magnet therapy products and purchase them for themselves.

Today, increased advertisement, educational books, and celebrity endorsements have made the public more aware of the ancient practice of magnet therapy. One can expect that the scientifically 'illiterate' public will be convinced by these books and celebrity endorsements.

Chapter 3: Evidence

This chapter will present the currently available evidence as to the validity of magnet therapy. Past medical studies involving magnet therapy devices will be analyzed to determine whether they were scientifically sound and their conclusions will be presented. Theories as to the functioning of magnet therapy devices, such as increased blood flow and pain blocking, will be explained and analyzed.

3.1 Medical Studies

The validity of magnet therapy is a pressing question to the modern day field of medicine. There have been only a handful of well-known medical studies on the effects of magnets used to alleviate pain. Some of these studies offer evidence that suggest magnets are successful in alleviating pain while others conclude that the magnets have no effect at all. The following five medical studies concerning magnet therapy were found by this IQP group. Several are very recent, while others are almost ten years old. Almost all of the studies were fairly hard to find. The most important information from each study can be found summarized in a table at the end of this section.

The most famous and controversial medical study concerning magnet therapy was done by Dr. Carlos Vallbona in 1997. It is a double-blind study concerning the effects of magnets on adults suffering from post-polio syndrome. The study was conducted at the Baylor College of Medicine and The Institute for Rehabilitation and Research (TIRR) in Houston, Texas. Dr. Carlos Vallbona, professor of family and community medicine and physical medicine and rehabilitation at Baylor College and

director of the Postpolio Clinic at TIRR, led this study (Barrett, 1999). A total of 50 people, 39 women and 11 men, were involved in this study. The patients were first asked to press on the place where they experienced the worst pain, their "trigger point," and rank that pain on a scale of 1 to 10, with 10 being the most severe. They were then randomly issued devices containing either active or inactive magnets. The magnetic insoles, which were provided by the Bioflex Corporation, ranged in magnetic field strength from 300 to 500 gauss. Neither the patients nor the staff knew which magnets were the legitimate ones. The patients strapped the magnets to their trigger points for a period of 45 minutes. After this interval, the magnets were removed and the patients were asked to rate the severity of their pain again. Of the 29 people given active magnets, the average pain intensity of the patients was 9.6 before the use of the magnets and 4.4 after treatment. The group of patients with the inactive magnets had an average of 9.5 before treatment, and 8.4 after the magnets were removed. The group of patients that were issued the active magnets showed a significant decrease in the intensity of their pain, whereas the placebo group showed little or no changes. The authors of this study concluded that magnets have a positive effect for pain relief of patients suffering from postpolio syndrome (Vallbona, 1997).

A rather obscure study dealing with magnet therapy was conducted at the New York College of Podiatric Medicine and dealt with the effects of magnetic insoles on patients with chronic heel pain. In this study, a total of 34 people suffering from this ailment were randomly issued molded insoles, some containing a magnetic foil and others containing no foil. The patients wore these insoles for a period of 4 weeks. About 60% of the patients in both groups reported an improvement in their pain

(Barrett, 1999). From these results, there was no substantial evidence that the magnetic foil had any positive effects on the patients. The authors of this study concluded that the insoles containing the magnetic foil had no effect on the improvement of chronic heel pain.

A similar study concerning heel pain was conducted at the Barry University School of Podiatric Medicine. Similar to the Baylor study, the Bioflex Corporation provided the magnets for use in this study. This was a double blind study consisting of twenty people ranging from 21 to 78 years of age and experiencing the same symptoms. They were issued pads that were randomly mixed prior to the start of the trial. The placebo pads and the magnetized pads looked and felt identical so that neither the patients nor the clinicians could tell the difference. All of the pads were coded and only an impartial referee knew which pads were authentic and which were not. After periods of seven days, all of the patients were evaluated. The documentation of the results were based on four predetermined criteria (Seaman, 1991):

Criterion A: Subjective pain sensation.
Criterion B: Ability to ambulate without pain.
Criterion C: Need for pain or anti-inflammatory medication.
Criterion D: Accompanying therapy.

The patients were then asked to rate each criterion based on three categories: excellent, good, and fair or no better. The percentage of improvement in the group using the magnetized pads was 57.2% in the relief of pain and 77.1% for improvement in walking. For the control group, the relief of pain and improvement was 16.6%. For

criteria C and D, none of the patients in either group needed medications or accompanying therapy, so both groups experienced 0% improvement for each of these criteria. The study concluded that the use of the magnetized pads gave a higher percentage of favorable results in all criteria than did the demagnetized pads used in the control, and therefore had a positive effect in the patient's relief of their symptoms. The 16% within the control group that showed improvement in criteria A and B were attributed to the placebo effect (Seaman, 1991).

The Holcomb HealthCare company has conducted a number of studies at Vanderbilt University using their patented product Magna Bloc™. A few of the studies conducted dealt with measuring pain intensity in human patients before and after the use of this magnetic device. These patients were suffering from knee and lower back pain and pain associated with inflammatory arthritis. The study conducted on patients with knee and lower back pain concluded that, of the 54 people in the study group, almost all experienced a reduction in pain during an active treatment period as compared to during a placebo period. "Patients were observed to use less analgesics (painkillers) during the active Magna Bloc™ treatment than during the placebo treatment" (Holcomb, 1991). Also, the largest improvement was measured after 24 hours of treatment as opposed to 1 or 3 hours, clearly showing the importance in the duration of treatment. Another of the studies conducted used magnetic fields on cultured neurons in order to measure the amount of blockage of the neuron firing as a direct result of the magnetic field. A proposed mechanism by which the magnet apparently prevents the nerve from firing is offered in one of the studies. The Magna Bloc™ product is an array of four permanent magnets of alternating polarity. The

magnetic field produced by this array has a steep gradient that blocks the firing of sensory neurons in cell culture that have sodium-dependent action potentials. "The same array has been shown to block calcium-dependent action potential firing simultaneously in the same neurons . . . Conformational changes within the ion channels and/or neuronal membranes may explain these findings" (Holcomb, 1999). The conclusions of the several Holcomb run studies were that magnet therapy devices were able to block pain, both in patients and in single neurons. It must be taken into consideration, however, that Robert R. Holcomb, one of the many people directly involved in conducting these studies, is a major stockholder of the Holcomb HealthCare company. Also, not all of the studies used a control/placebo group with which to compare the results.

The most recent medical study published during the completion of this IQP is one published in the March 8th, 2000 *Journal of the American Medical Association* (JAMA). This study, titled "Bipolar Permanent Magnets for the Treatment of Chronic Low Back Pain", was a randomized, double-blind, placebo-controlled, study conducted from February 1998 to May 1999 by Dr. Edward A. Collacott. The study was completed at the Veteran's Affairs Hospital in Prescott, AZ with the approval of the institute's review board. Of the three doctors who ran the experiment, two of them were residents at the hospital, while the other was a staff member of the Bio-Electro-Magnetics Institute in Reno, NV. Twenty patients suffering from chronic low back pain were issued either a therapeutic bipolar permanent magnet with a field strength of 300 G or a matching placebo. The real or false magnetic devices were "applied, on alternate weeks, for 6 hours per day, 3 days per week for 1 week" (Collacott, 2000).

Both the range of motion and pain rating of the patient were nearly unchanged from before treatment for either the real or false magnetic devices. In conclusion, this variety of permanent magnet had no effect on this small group of patients with chronic low back pain.

Table 3.1 below, summarizes the five medical studies currently available on the subject of magnet therapy. It gives the main doctor, university, or publication, the aliment on which the study was conducted, the date of publication, and whether the conclusion was positive (supporting magnet therapy) or negative (opposing magnet therapy).

Table 3.1

Study	Ailment Studied	Date	Conclusion
Barry University	chronic heel pain	1991	+
Holcomb	knee/low back pain	1991	+
Vallbona	postpolio syndrome	1997	+
N.Y.College of Podiatric Medicine	chronic heel pain	1999	-
JAMA	chronic low back pain	2000	-

This concludes the medical studies currently available on magnet therapy. There is only one widely known study currently being conducted on magnet therapy. The University of Virginia has been receiving NIH funding for studies dealing with magnet therapy for a number of years, but has yet to publish any medical studies during the time span of this IQP. The University of Virginia's study results are highly anticipated by both magnet therapy proponents and skeptics alike.

3.1.1 Medical Study Analysis

The analysis of the medical studies presented in Section 3.1 will consist of a comparison between the Vallbona study and the study conducted by Dr. Collacott and published in the JAMA, and an examination of the publicity, funding, reliability of journals for the different studies.

Many comparisons can be made between the most talked about and the most recent medical study involving magnet therapy. The study published by Dr. Carlos Vallbona, "Response of Pain to Static Magnetic Fields in Postpolio Patients: A Double-Blind Pilot Study," in the 1997 *Archives of Physical and Rehabilitative Medicine,* is the most talked about and referenced study involving magnet therapy. The study published by Dr. Edward A. Collacott, "Bipolar Permanent Magnets for the Treatment of Chronic Low Back Pain," in the March 8, 2000 *Journal of the American Medical Association,* is the most recent study involving magnet therapy. When the two studies are compared valuable information is gained. Both were double-blind, placebo-controlled studies, but the Vallbona study used a larger test group than the Collacott study: 50 versus 20 people. Another major similarity is that both studies used nearly the same magnetic field strength devices: 300 G. However, while the two different studies did use the same strength magnets, they did not use the same durations of treatment. In the Vallbona study, the magnetic devices were applied for 45 minutes. In the Collacott study, the magnets were applied for 6 hours per day, 3 days per week, for 1 week. This treatment time is much greater than that of the Vallbona study. The longer testing period may allow for a better measurement of the effect of the magnetic device on the patients' pain. The most glaring difference

between these two studies is that each study tested the magnetic devices on different forms of pain. The Vallbona study was conducted on patients with postpolio syndrome, whose manifestations were general muscle pain. The Collacott study was conducted on patients suffering from low back pain, to quote the study itself, the patients exhibited ". . . the degeneration of the 3-joint complex (intervertebral disks and facet joints) . . . " (Collacott, 2000). Essentially, the Vallbona study dealt with simple muscle pain, while the Collacott study dealt with pain in the joints and disks of the lower back. Hence, a systematic comparison of the two studies might not be appropriate. Even the final sentence of the Collacott study supports this conclusion: "The source of pain in our participants would appear to be deeper than that of the former (Vallbona), and may explain the lack of beneficial effects from the magnets used" (Collacott, 2000). Although the studies were observing the effects of the magnetic devices on different ailments, the longer duration of testing time in the Collacott study would allow for a better measurement of the effects. That fact would make this study more reliable since it would allow for a better range of scientific analysis.

An important factor in considering the data and conclusions from any study is to take into account the journals they were published in, funding for these studies, and also the media attention to these studies. For instance, the Vallbona study, published in 1997, has been mentioned and cited in almost every magnet therapy book, newspaper and magazine article, and internet website that was found dealing with magnet therapy. Essentially, it is the study referred to by the media in the discussion of magnet therapy. On the other hand, the Holcomb studies, dating back to 1990 and

1995, are not mentioned in any book, article, or major source that this group has examined. This may be due to the total obscurity of the journals they were published in. The Holcomb studies were published in the following journals: *Bioelectromagnetics*, *Environmental Medicine*, and *The Journal of Clinical Rheumatology*. After extensive searching, we determined that these journals were not carried by many libraries and in some cases were not peer reviewed. *The Journal of Clinical Rheumatology* is not peer reviewed, meaning there is no quality control by experts in the field. In fact, it is more of a newsletter than a journal, and can only be found in 22 libraries across the United States. The journals *Environmental Medicine* and *Bioelectromagnetics* are both peer reviewed, but can only be found in 4 and 106 libraries, respectively, across the U.S. Essentially, these are all very obscure journals in their own field. The only way we were able to examine the studies performed by Holcomb was via the Magna Bloc™ website (http://www.holcombhealthcare.com/pubdata.html). The Holcomb studies can also be found through a link in the Vanderbilt University website. Robert R. Holcomb received his M.D. and Ph.D. from Vanderbilt University and is currently a physician in Vanderbilt's Center for Pain Research & Neuromagnetics. His previous studies have been conducted at and with the assistance of Vanderbilt University, and he currently has seven papers under review for publishing. It is difficult to determine whether the studies conducted by Holcomb are in any way funded by Vanderbilt University. However, the fact that his studies of magnet therapy are listed on the Vanderbilt University website would imply that the University supports his work.

A majority of the medical studies examined by this IQP group were difficult to find and in almost all cases never mentioned by the media. However, the most recent medical study published in the Journal of the American Medical Association was easy to find, referred to by the media, and published in a highly reputable journal. The difficulty of finding some journals may be due to their obscurity or could be due to a bias by the scientific community in respect to magnet therapy, making it extremely difficult to publish magnet therapy documentation in reputable and popular journals.

The upcoming publication of the University of Virginia's studies on magnet therapy have also been highly publicized and anticipated by the scientific and magnet therapy community. The NIH, a highly reputable scientific organization, has been funding studies at the University of Virginia for several years. This study has been highly publicized in newspaper articles and other medical studies, and even Dr. Robert Park, the American Physical Society (APS)'s director of public affairs, states in his 1999 article for the Washington Post that "The University of Virginia is finishing a two-year, double blind study of devices sponsored by the National Institutes of Health's alternative medicine office and results are to be announced soon" (Park, 1999). That this increased interest within the scientific community by such reputable scientific groups as NIH and JAMA, may suggest that the perception of magnet therapy within the scientific community is changing.

Of the five currently available medical studies concerning magnet therapy, summarized in Table 3.1, the conclusions reached by each are quite contradictory. Several studies claim magnet therapy devices helped relieve the pain of suffering patients, while other studies show no effect of the magnetic devices. However, more

recent studies published in highly reputable medical journals have been comparing and contradicting claims of earlier studies. Such is the case with the most recent magnet therapy study published in the Journal of the American Medical Association. Even with these most recent study results opposing magnet therapy, organizations such as JAMA and NIH are giving credibility to the practice of magnet therapy by simply funding and involving themselves with this form of treatment. The scientific community is changing in regard to magnet therapy though many still feel that it is 'quackery.' However, even their most basic involvement in the study of magnet therapy is giving this practice credibility, especially in the eyes of the scientifically 'illiterate' public.

3.2 Magnet Therapy Physics

A majority of all commercially sold magnet therapy products are those that emit a static, or unchanging, magnetic field. These devices are available in a variety of configurations such as pads, bandages, and even magnetic mattress pads. Physics can be used to predict the interaction of magnetic and electric fields within the human body.

3.2.1 Basic Magnet Physics

There are two measures of magnetic field strength: gauss (G) and tesla (T), where 1 T = 10000 G. The magnetic field strength generated by the earth is approximately half a gauss (Tipler, 1976). Commercially sold magnet therapy products range in magnetic field strength from several hundred gauss to several

thousand gauss. This field strength varies, however, depending on the distance from the magnet. Table 3.2 below, shows the magnetic strength in gauss at 6 inches from various devices (Park, 1999).

Table 3.2

Device	Magnetic field (G)
Big-screen television	0.05
Earth's magnetic field at surface	0.5
Hair dryer or electric shaver	0.7
Electric can opener	1.5
Magnetic Resonance Imaging (MRI)	30,000

A pad containing magnets with field strength of 270 G at the level of the pad has been found to have field strength of 1 G at a distance of 1 cm from the pad. This is due to the fact that the magnetic field strength is roughly proportional to one over the distance squared. So, as the distance from the static magnetic field source increases, the field strength decreases. An example of this is a 4000 G magnet which transmits only about 1200 G to a patient. Even so, these are very weak magnetic fields when compared with those of several thousand gauss, easily produced by Magnetic Resonance Imaging (MRI) for medical diagnoses and research, and yet no ill effects are felt from exposure to MRI fields.

A factor of key importance to the function of magnet therapy is the type of material the magnet is composed of. The following table, Table 3.3, shows commonly used types of magnets and their respective magnetic field strengths (http://www.relievepain.com).

Table 3.3

Type of Magnet	Magnetic Strength (G)
Flexible (iron)	30 - 2500
Ceramic (strontium ferrite)	3800 - 3950
Alnico	8200
Samarium Cobalt	9000
Neodymium	10800 - 12000

All of these commercially sold magnet therapy devices are made from materials that are ferromagnetic. Ferromagnetic is a term meaning the material will always generate a static magnetic field. These materials are called ferromagnetic because their best known member is iron. Other materials include cobalt, nickel, and their alloys. These materials are distinct from diamagnetic and paramagnetic materials, which do not always generate a magnetic field, and have the following properties (Sadiku, 1995):

1. They are capable of being magnetized very strongly by a magnetic field.
2. They retain a considerable amount of their magnetization when removed from the magnetic field.
3. They lose their ferromagnetic properties and become paramagnetic materials when the temperature is raised above a critical temperature.

The materials' ability to become magnetized and retain their magnetization are the factors responsible for the differences in their magnetic strengths. Materials such as Neodymium and Samarium Cobalt can be more strongly magnetized than simple iron

and are therefore able to produce stronger magnetic fields. The 1995 edition of Encyclopedia Americana states that permanent magnets, such as refrigerator magnets, were formerly made from steel, but steel has largely been replaced by complex alloys containing iron, nickel, or aluminum. These are known in the United States as Alnico alloys. Today, permanent magnets are manufactured by taking the elements in powdered form and pressing them under extreme heat in a magnetic field (Whitaker, 1998). The resulting mass, called sinter, is then magnetized using an intense magnetic field, a process that takes only a microsecond (Whitaker, 1998). Many companies have a strict policy about telling the public how their magnets are made or from where they are imported or produced. However, several magnet therapy devices examined by this IQP group had the words 'Made in China' or 'Made in Taiwan' on the product box.

Unfortunately, very few magnet therapy retailers mention what materials their devices are specifically made from, so comparing the price and material is very difficult. A company called Norso Biomagnetics, advertises a single Neodymium magnet of strength 12000 G to cost between $15-$25, depending on the size. This company also advertises a pillow pad composed of 28 ceramic magnets (magnetic field strength 3950 G) to cost $40. So, clearly the stronger the magnetic field, the more the magnetic device costs. It should be noted, however, that these strong permanent magnets were unheard of years ago, even in research labs. Thus, scientific research has allowed the commercialization of strong magnets and, as a result, made magnet therapy more affordable.

Physicist's opinions are essential when examining the functioning of scientific devices. The American Physical Society (APS)'s director of public affairs, Dr. Robert Park, heralded a campaign against so called 'voodoo science', of which he believes magnet therapy is a part. Park has written several articles for the New York Times and Washington Post debunking the claims of magnet therapy proponents. Park talks about taking a magnet therapy device and placing it on his refrigerator, then adding sheets of paper between the device and the metal. He claims the device will only support ten sheets of paper before the magnetic field becomes too weak and the device falls to the floor (Gwynne, 1999). This demonstrates to Park that the magnetic field is so small and has such a limited range, that it is incapable of affecting the human body. However, his simple tests must involve a simple flexible iron magnetic device, not a magnet therapy device made out of the ten times more powerful material Neodymium. Park has yet to comment on the latest magnet therapy advances in producing more powerful magnets. Another physicist, from Oakland University, A.R. Liboff, realizes the implication new, more powerful magnetic materials are having on the industry. "The increase in marketability of permanent magnets for pain relief is largely due to the discovery of new, high coercive force materials" (Liboff, 1998). Materials, such as Neodymium and Samarium Cobalt, "having less self-demagnetization and very thin geometries are now capable of producing fields of about 0.1 T (1000 G) within a few millimeters" (Liboff, 1998) of the magnet surface. These more powerful, thinner magnets are more likely to affect the human body than magnets previously sold.

3.2.2 Increased Blood Flow Theory

One of the main theories put forth by proponents of applying static magnetic field therapy to injured or painful tissues is that these devices cause an increase in local blood circulation. Blood, like all tissue, contains electrically charged ions. Faraday's Law of electricity and magnetism states that a magnetic field will exert a force on a moving ionic current (Tipler, 1976). An extension of Faraday's law, the Hall Effect, states that when a magnetic field is placed perpendicular to the direction of flow of an electric current, it will tend to deflect and separate the charged ions (Tipler, 1976). The Hall Effect implies that when a magnet is placed over flowing blood in which ionic charges (such as Na^+ and Cl^-) exist, some force will be exerted on the ions (Whitaker, 1998). Furthermore, the separation of ionic charges will produce an electromotive force, which is a voltage between points in a circuit. These physical effects, which do exist, provide the basis for one theory as to the function of static magnetic field therapy.

When a magnetic field with a series of alternating North and South poles is placed over a blood vessel, the influence of the field will cause positive and negative ions (for example, Na^+ and Cl^-) to bounce back and forth between the sides of the vessel, creating flow currents in the moving blood similar to those in a river. The combination of the electromotive force, altered ionic pattern, and the currents may cause an increase in blood flow.

The problem with using Faraday's law and the Hall Effect to explain the supposed effects of static magnet therapy products is that the magnitude of that force applied by the field is infinitesimally small. Two factors account for the lack of effect.

First, the magnetic field applied to the tissue is extremely weak, which may be the reason many magnet therapy proponents support the use of strong magnets. Second, the flow of the ionic current, in this case blood flow, is extremely slow, especially when compared to the flow of an electric current through a metal. However, it is still possible to estimate the forces applied to flowing blood by a weak magnetic field as long as the strength of the magnetic field applied, the velocity of the flowing blood, and the number of the ions in the blood are all known.

Considering an applied magnetic field of 250 G (0.025 T) and the speed of blood flow, *v*, of 1 cm/sec (0.01 m/sec), the electro-motive force or change in electric potential across a 1mm-diameter blood vessel can be calculated as (Ramey, 1998):

$$E = v \cdot B \cdot l = 0.01\text{m/s} \cdot 0.025\text{T} \cdot 0.01\text{m} = 2.5 \times 10^{-7}\,\text{Volts} \qquad (1)$$

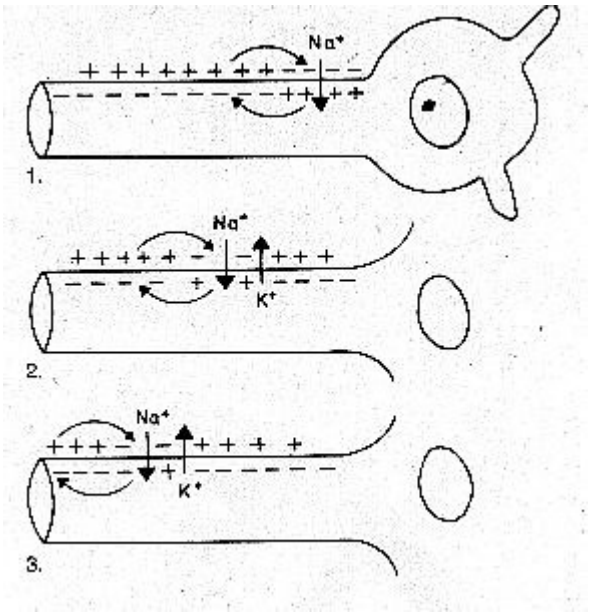
Ions of opposing charge will move in opposite directions when moving through a static magnetic field. The separation of charges, known as the drift velocity, can also be calculated. In the case of Na^+ and Cl^- ions in flowing blood under the influence of a 250 G magnetic field, the increased separation of the positive sodium and the negative chloride ions will be about 0.2 Angstroms per second, or about 1/10 the diameter of an atom. This can then be compared to the random drift distance that results from the thermal excitation caused by the heat of the body, which is about 0.25 mm/sec (Ramey, 1998). In other words, the ions will travel farther from thermal excitation than from the 250 G magnetic field force by a factor of about 10 million. Dr. Robert Park also supports this conclusion to the increased blood flow theory

saying that this effect has never been observed "even at the huge field strength of MRI magnets (30,000 G)" (Park, 1999). Park goes on to disprove another part of the increased blood flow theory: that iron in human blood is drawn to the magnetic devices. Park states that "the iron in hemoglobin, is in a chemical state that is not ferromagnetic- that is, not attracted to a magnet" (Park, 1999).

3.2.3 Pain Blocking Theory

Another, more biologically based theory for the functioning of magnet therapy devices is the inhibition of pain receptors. Nerve cells are what the human body uses to transmit pain from the part of the body experiencing the stimulus to the human brain. When the human nerve cell is at its resting potential there are sodium ions (Na^+) outside the cell and potassium ions (K^+) within the cell. These two sets of ions are separated by a thin cell membrane, which is selectively permeable, so at all times there is a small flow of Na^+ and K^+ ions in and out of the cell. Essentially, there are two opposite forces at work within the nerve cell: a concentration gradient of potassium pushing K^+ out of the cell and an electrical gradient between the two groups of charges driving K^+ into the cell (Brodal, 1998). When these two forces are equally strong the cell is at equilibrium. Also while at equilibrium, the membrane permeability for Na^+ is low. When the nerve cell is at equilibrium, the difference in charge across the cell membrane is –60mV, which acts to keep the K^+ ions within the cell. When a stimulus is sensed, neurotransmitters act to greatly increase the Na^+ permeability of the cell membrane. Thus, an action potential is created across the cell and a majority of the Na^+ ions flow into the nerve cell, forcing the K^+ ions out (Brodal,

1998). The Na^+ ions flow into the nerve cell in a chain reaction along the entire length of the cell and to an adjacent neuron. One nerve cell fires another and this occurs until the signal reaches the brain and the sensation is interpreted as pain. This in-flow of Na^+ ions down the length of the nerve cell can be seen in Figure 3.1.



(Brodal, 1998)

Figure 3.1: The nerve cell fires as Na^+ ions move through the cell membrane down the length of the cell, from 1.->2.->3.

In this sense, waves of charges switch sides of the cell membrane, cascading down the length of the nerve cell. These waves are the nerve cells firing. This action potential then carries on to the next nerve cell in series until it reaches the brain. The frequency and pattern of the action potentials allow the brain to interpret the pain stimulus.

Proponents of magnet therapy theorize that the placement of magnetic devices on the injured or painful area will inhibit some pain signals from reaching the brain, in effect, lessening the pain. They claim the static magnetic fields will block the action

potential in a nerve cell, stopping the Na^+ ions from entering the cell membrane, essentially stopping the nerve cell's message from going to the brain. However, it has already been shown how negligible the effect a magnet therapy device has on the movement of ions within the blood. Based on these calculations, the minute force the magnetic field exerts on the ion is most likely not sufficient to prevent the Na^+ from entering the cell and causing the nerve cell to fire.

Any magnetic forces generated by a static field affecting fluid movement through blood vessels and nerve cells would have to overcome both pressure-driven forces and those caused by thermal excitation of the particles in the human body. Many physical forces already exist in blood vessels and cells that are much stronger than those generated by a static magnetic field.

Chapter 4: Industry

The sales of permanent magnet therapy products are increasing yearly and business is booming for the magnet therapy industry. Worldwide sales of magnet therapy products have been estimated at $2 billion in 1997 (Lawrence, 1998). Important in considering the growing magnet therapy industry are the companies that sell these products. Do the companies simply want to make a profit by selling a product they don't believe in, or are they genuinely interested in the relief of their customers? Are the funding studies researching the validity of magnet therapy? Another important consideration is the groups that monitor and regulate this growing industry. Both the Food and Drug Administration (FDA) and National Institutes of Health (NIH) are responsible for protecting the health of the public and, therefore, must monitor this growing industry. Altogether, the growing magnet therapy industry must be examined as to whether it responsibly sells a legitimate product or is just out to make a profit at the cost of the consumer.

4.1 The Growing Industry

The magnet therapy industry in North America has been growing due to the "booming annual business estimated at anywhere from $150 million to $500 million a year" (Allen, 1999). A Florida-based magnet therapy company, Magnetherapy Inc., recently commissioned a marketing study, which found the U.S. market for magnet therapy products for 1999 to be $300 million, up $100 million from last year, and over $1.5 billion worldwide (Allen, 1999). The study also projected a $600 million U.S. market by 2003. A key example of the growing industry is the Japan based company

Nikken, Inc., which has developed more than 60,000 distributors in the last seven years "through an Amway-style networking program" (Seekins, 1998). These distributors were essentially average people who, in their free time, would be salesmen for the company. They would tell their friends, or perhaps go door-to-door, trying to get people to buy magnet therapy products from this company, thus earning themselves a commission from the sale. These distributors, combined with a multilevel marketing scheme, have expanded the company's annual business in the U.S. from $3 million in 1989 to $150 million in 1998 (Livingston, 1998). These growing sales are attributed to the fact that millions of Americans are using natural alternative medicine. "Worldwide, over 100 million people use magnet therapy: 30 million in Japan alone, where 10 million sleep on magnetic beds to counter the effect of stress, fatigue, arthritis, sciatica, carpal tunnel, asthma, migraines, and more" (http://www.buyamag.com/cgi-bin/html/info.htm). In addition, magnet therapy is also being used to treat horses since $3.5 to $4 million worth of magnets were sold to horse owners in 1997 (Lawrence, 1998). These facts on market growth and size were found in many sources: books, newspaper articles, and websites, several of which are obscure and should be compared against each other and the findings of further market research. When compared together, several figures are millions of dollars off, generating a large margin of error. Such is the case with the Nikken annual sales figure of $150 million in 1998 compared to Magnetherapy Inc.'s study which estimated the U.S. market in 1998 to be $200 million. In essence the industry and market are growing rapidly, but no one is exactly sure of the current market size or the growth over the last couple of years.

Another type of statistic which shows magnet therapy's growing popularity and in turn the industry's growth is the date of publication of medical studies, books, and articles relating to magnet therapy. All of the self-help books supporting magnet therapy were published after 1990. Likewise the medical studies concerning magnet therapy were published after 1991. Also, the many magazine articles and newspaper stories on magnet therapy were not constantly presented to the public until after 1990. It can clearly be seen from this analysis that the popularity of magnet therapy started growing in America sometime after 1990. Over the last ten years, the American public has turned a little known form of holistic medicine into a several hundred million dollar industry.

4.2 Company Interviews

Interviewing people who work in the magnet therapy industry was also essential in examining this growing industry. People who sell magnet therapy products and those who work within the industry know vital information about the business practices and sales techniques of magnet therapy companies. Several magnet therapy companies were contacted and a salesman of the product, Magna Bloc, Inc., was interviewed.

The IQP group learned that a graduate student in the physics department of WPI was associated with Magna Bloc, Inc. and its products. The goals of the interview were to determine the type of advertising, if any, that Holcomb Health Care (HHC) was using, sales figures, the materials the magnets are made from, and customer response to this product. HHC primarily advertise their products through

various catalogs and select websites, such as www.quixtar.com. Also, the graduate student stated that he is not directly affiliated with Holcomb Health Care. He is an 'independent business owner' through the Quixtar website. Since he is only connected through this website, it was not possible to obtain information regarding the HHC's sales figures. No new information was gained from this interview regarding any current studies involving magnet therapy by HHC. However, we were able to determine from the interview that HHC uses magnets produced from rare earth elements, but could not determine whether or not the materials were imported or produced in the U.S. As for the company's advertising it was learned that HHC uses word of mouth advertising in addition to the above methods.

Several companies were also informally interviewed about their products. To obtain an accurate and non-biased conversation with the sales representative, they were not informed that their answers were going to be used in this IQP, the IQP group members simply posed as customers. Since the companies were not informed as to the use of their responses for this project, their names will not be mentioned. When the group inquired about the strength of the magnetic products that were being sold, the companies responded by stating that depending on what the products were intended for, determined the magnitude of the magnetic field strength. An example of this is that a magnetic shoe insert would have a magnetic field of 2500 G, whereas a bracelet would have 1200 G magnetic field. The response to the question, 'What material are the magnets made of?,' was that they were made of a variety of metals and ceramic materials, or as in several cases, the sales representative did not have the information to answer the question. Even after informing them that the group members were

scientists they still were not able to produce accurate scientific information about their products.

There were a variety of responses to the idea that a scientist was inquiring about their product. Some group members received no change in behavior and continued to talk to the sales representative. Other group members received hostile behavior after revealing that he/she was a scientist, and shortly after that, the session ended. The prices of the magnetic products ranged from approximately $20 to $170 depending on the product. The response to the question 'How does magnet therapy work?' was that it increased the blood flow at the location of the magnet, making it easier for red and white blood cells to enter painful parts of the body. The companies made no comment about what the dosage time of the magnetic therapy products was. Also, the company's sales representatives had no comments as to whether a magnetic product would cause pain if worn for an extended period of time.

One thing of particular interest was that every sales representative contacted, stated that they had personally used and had success with magnet therapy products. They all claimed to have experienced dramatic improvements in various types of pain after wearing the magnetic product. At the conclusion of the interviews, several companies referred the interviewer to their website for further information.

4.3 Magnet Therapy Regulation

The United States Food and Drug Administration (FDA) and the National Institutes of Health (NIH) are the agencies that deal with the regulation of magnet therapy at this time. It has been suggested, by a high ranking official of the FDA that

wishes to remain anonymous, that other governmental agencies will soon be involved with this industry and its increasing attraction as an alternate method of pain relief.

The FDA regulates manufacturers on their advertisement of the use of medical substances and medical devices. The regulations that they put on the devices are used to prevent the public from being misled and misinformed about the abilities of the products. Other regulations ensure that the public is aware of the harmful effects that a material or device may produce if used. Section 201 (h) of the Food and Drug Administration Modernization Act of 1997 defines a device as "an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component, part, or accessory, which is: recognized in the official National Formulary, or the United States Pharmacopoeia, or any supplement to them, intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, in man or other animals, or intended to affect the structure or any function of the body of man or other animals, and which does not achieve any of its primary intended purposes through chemical action within or on the body of man or other animals and which is not dependent upon being metabolized for the achievement of any of its primary intended purposes." Using this definition given by the FDA, it is clear that magnet therapy products, which require the use of static magnets, should be classified as a medical device. Therefore these products should be regulated so that people looking for alternative ways to deal with their pain are not misled by manufacturers' claims about the capabilities of their products. At the present moment, the popularity of alternative medicines are increasing, as is their use. The abilities and limitations of magnet therapy products

should be publicized to consumers. This would prevent the sale and distribution of magnet therapy products advertised as being able to prevent or cure infectious diseases, viruses, or other health conditions.

The advertisements of magnet therapy products range in claims from being able to block pain to being able to prevent the common cold or curing AIDS. When the FDA was questioned as to why magnet therapy products have so many different advertisements in the public view, several directors and other high ranking people within the FDA, wishing to remain nameless, stated that magnet therapy is not a top priority of the FDA. Even so, the FDA has been and currently is watching the claims made by magnet therapy retailers. The majority of the magnet therapy distributors, state that their products are able to reduce pain and cause the rate of healing to increase. But these types of effects are very subjective, depending on the different people using these products or different environments the devices are used in. A person may heal naturally faster than another person with the same injury due to genetics or to the outside environment. These companies can essentially hide behind the defense that their products only alleviate pain. One company, Magnetic Ideas, Inc., has a disclaimer on their website that advertises their products:

Magnetic Ideas, Inc. does not diagnose nor prescribe.
Magnet therapy products are not sold as medical devices.
Our magnetic products are not sold to cure disease.
No guarantee of effectiveness is made.
Magnetic therapy is not intended to replace
any instructions or prescriptions prescribed by your doctor.

The FDA, due to limited funds, will only regulate magnet therapy products that have been advertised to stop an infectious disease or virus. Essentially, the FDA has no power over a product that simply makes general claims to alleviate pain and stress.

Presently, the FDA may be investigating several magnet therapy products for false or misleading advertising in their use. Under federal law, it is prohibited that any person associated with the FDA give any information about any product while it is being investigated or applying for approval. It is possible that there might be several magnet therapy companies that are under investigation or are currently applying for approval and are awaiting a FDA decision on their device. The FDA has, however, sent warning letters to some magnet distributors demanding an end to unsubstantiated claims (Ingelzi, 1997). And in several cases, the FDA has cited companies which claim magnet therapy can cure serious illnesses, such as AIDS or cancer (Allen, 1999). These misleading or false advertisements are mainly due to the high potential for profit in the magnet therapy industry, because of an increase in the popularity of alternative medicines.

The NIH is also responsible for investigating the claims made by manufacturers dealing with substances and devices. At the present time, they are investigating alternative medicines, but they are not specifically investigating magnet therapy and its devices. At the University of Virginia, the Center for the Study of Complementary and Alternative Therapies (CSCAT) has been studying alternative methods of stopping or reducing pain. The CSCAT is studying the ways in which magnets affect biological tissue and other related areas. CSCAT associates, when interviewed, gave minimal information about what they were investigating. The

information that was given was that they are studying alternative methods of how to stop or reduce pain. Their reasons for not providing more information was that they were afraid that if they gave any data or information about the procedures or tests that they were performing at the moment, that other groups would steal their techniques and information. Then, they could publish a paper before the CSCAT, using the same procedures and data. It is clear that their position on the distribution of information has definitely hindered this IQP group's investigation into what the NIH is doing in regards to magnet therapy research.

The NIH is also in charge of distributing large amounts of money for research into health technologies. The amount of money that the NIH granted CSCAT was approximately $1.5 million in 1998. In 1997, the NIH Office of Alternative Medicine gave a million-dollar grant to Dr. Ann Gill Taylor of the School of Nursing of the University of Virginia to study the use of magnets to relieve pain (Livingston, 1998). She will be testing the effectiveness of magnetic sleep pads in relieving pain in patients suffering from fibromyalgia, a disease involving joint and muscle pain.

It is clear that both the FDA and NIH are investigating magnet therapy advertising as well as magnet therapy devices. However, both groups refusal to provide any information on the study of magnet therapy has left many unanswered questions with respect to this IQP. Much effort was put in an attempt to gain information from these agencies, but due to the politics of governmental agencies, federal laws, attitudes of people within these groups, and prevention of the loss of accreditation, only minor information as to the FDA and NIH involvement in magnet therapy regulation has been acquired.

The magnet therapy industry has grown considerably over the last ten years. The yearly sales of magnet therapy products are somewhere between $1.5 and $2 billion, worldwide. Magnet therapy retailers and representatives have been questioned and interviewed to determine the sales practices and views of this growing industry. In addition, groups that regulate health products sold to the public, such as magnet therapy, have been contacted. Although magnet therapy may not be a top priority with these regulatory groups, they continue to monitor this growing industry.

Chapter 5: Public Awareness & Belief in Magnet Therapy

5.1 Introduction

In order to determine the public's perception of magnet therapy, surveys were conducted. The main goal of this is to draw conclusions about people's awareness and belief of magnet therapy based on such groupings as age, income and education. A survey was determined to be the best way of gathering the public's responses on the subject of magnet therapy. After considering the cost of mailing out several hundred or thousand surveys through the US Post Office, it was decided other methods of implementing the survey would be more effective for this particular project. Since any form of national survey on magnet therapy would be too expensive, local surveys would be necessary to gauge the public. Since several members of the IQP group had previously participated in surveys through the Worcester Polytechnic Institute (WPI) mail service, it was decided that the surveys should be mailed out to WPI students. This is a fairly easy and low cost venture, which would allow for research on a particular group as a case study. The survey was distributed to the WPI junior class, which is composed of college students of roughly the same age and income. Another method of implementing the survey would be to approach people at local shopping malls. This would hopefully provide a valid cross-section of the Worcester population and allow for the interpretation of answers based on the above groupings: age, income, etc. Finally, the publicity employed by magnet therapy companies must be examined since it has a direct effect on the public's awareness and belief in magnet therapy. The various advertisements in magazines and newspapers, television commercials and newsbroadcasts, and internet websites and ads, must be studied to understand how the

consumers are targeted or made aware as well as the direction in which the magnet therapy industry is headed.

A base survey was made, containing six questions on the topic of magnet therapy. This survey was versatile enough so that it could be slightly adjusted based on which group was receiving the survey. The first question asked if the person taking the survey believed in alternative medicinal practices. This was used to first gage the person's belief in alternative medicine, perhaps allowing a correlation to their belief in magnet therapy. The second question asked if the person had ever heard of magnet therapy, then went on to ask from which sources they had heard of magnet therapy. This question would show the person's awareness of magnet therapy and then allow the determination of the most popular source of information on this popular medical practice. The next question asked if the person would ever purchase a magnet therapy product. The fourth question asked if the person's doctor or medical professional had ever recommended magnet therapy. This question would investigate whether doctors were already using or recommending this alternative medicine. The fifth question asked if the person taking the survey had ever purchased a magnet therapy product. The sixth and final question asked if the person believed in the practice of magnet therapy. This question would show the person's belief in magnet therapy. The questions were repetitive and ordered in a certain way, intentionally. The purpose was to make the person taking the survey think about their response to each question and in some cases answer the same question twice to insure that their answers were consistent and the survey was valid. The next five questions were in no way related to magnet therapy, but were asked to determine the demographics of the survey

participant: gender, race, age, income, and education. The race of the people participating in the survey would not be used to draw conclusions from, but rather to determine the validity of the cross-section of population participating in the survey. In addition to the questions, a paragraph was included at the beginning of the survey explaining its purpose and why the responses of the person taking the survey were necessary. It was also important to tell the people participating in the survey that their responses would remain confidential, and to tell them how long it would take to answer the survey.

It was decided that the WPI students and shopping mall patrons would receive an almost identical survey, so the results could easily be compared in the analysis. The WPI junior class survey and shopping mall survey can be seen in Appendices A and B, respectively. The results of these surveys and research, correctly interpreted, will show the public's awareness and belief in magnet therapy based on age, income, and education.

5.2 WPI Survey

One of the easier methods to gain survey participation and in turn people's awareness and belief in magnet therapy was to conduct a survey at the Worcester Polytechnic Institute campus. A survey of WPI students would not provide a valid cross-section of the population, by any means, but would provide insight into a case study of WPI students. This group is roughly the same age with the same level of education and income. The next step was to determine how the survey should be offered to the WPI students. Two options were available: to mail out the survey or to

setup an internet/email survey. It was decided that a mail survey would receive the most response, as a student would be more inclined to quickly fill out a piece of paper and re-mail it than they would be to, after receiving an email, go to specific webpage and complete a survey. Also, the time and knowledge it would take to create a webpage capable of accepting and correlating data was considered in this decision.

The next step was to talk with the WPI inter-campus mail office, which was only able to mail students the survey when their name and WPI box number were on the survey. Another stipulation by the WPI mail office was that they would only deliver the surveys to specific classes of students, i.e. seniors, juniors, etc. or all WPI students- 3900 students total. It was decided that mailing a survey to all WPI students would involve too much work and be too costly. Therefore, it was determined that the best class to mail the survey to would be the Junior class, since they would be most likely to complete and return them, having already begun work on their IQPs and understanding their importance.

The WPI Administration Office allowed the printing of labels for an entire class of students at no cost, which was very helpful, since there are 610 students in the Junior class. The method in which the students would return the surveys once completed was to have them refold the survey exposing a return address label which when entered into the WPI inter-campus mail would return the survey to the mailbox of Melissa Michelon. With the labels printed and attached to the surveys, all but 27 of the 610 surveys were delivered to the WPI Junior class. There were 27 undeliverable surveys, a result of students who were off campus either interning or working on projects. The students were given ten days in which to complete the surveys and

return them through inter-campus mail. Of the 583 surveys mailed out, 110 (19%) were returned by the deadline. Professor James K. Doyle of the Social Sciences department at WPI was contacted and he stated that a 10-15% return is typical for a mail survey. He also stated that the return survey size was large enough to represent the WPI junior class.

The data provided in these surveys were then analyzed to determine the awareness and belief in magnet therapy of a set group of 20 year old, college educated, people: the WPI junior class. Before the statistical analysis software was utilized and the data from the surveys was inputted, it became apparent, from studying the completed surveys, that those people who had never heard of magnet therapy before would not be able to provide as much data as those who had heard of magnet therapy. The first two questions in the survey were answered accurately by all of the participants, but the remaining questions, which dealt with purchasing magnet therapy products and their belief in magnet therapy, were answered haphazardly by those people who had never heard of magnet therapy. It became obvious that the survey was asking people questions about a term they knew nothing of. It was as if we were asking the people if they believed in jasafrab or had ever purchased a jasafrab product, they did not understand the term and therefore could not accurately answer the question. Therefore, the answers given for questions four through six on the survey (seen in Appendix A) by those people who had never heard of magnet therapy (answered 'No' to Question 2) must be disregarded. With this condition set in place, the computers statistical software can now analyze the survey data.

Professor Joseph D. Petruccelli of the WPI Mathematical Sciences Department was then consulted to aid in the use of the statistical software and the inputting of data. With his help, a simple program was constructed to input the survey data. See Appendix C for how the data was entered into the computer. Statistical Analysis Software (SAS) was then used to analyze the data.

One of the first important determinations is the WPI junior's responses to the six magnet therapy questions. The below table shows the number of responses for Yes, No, or Unsure, and percentage of responses to the six survey questions.

Question # (Brief Description)	Yes (%)	No (%)	Unsure (%)
1. (Do you believe in alternative medicine?)	72 (65%)	12 (11%)	26 (24%)
2. (Have you ever heard of magnet therapy?)	72 (65%)	38 (35%)	0 (0%)
3. (Would you purchase a magnet therapy product?)	12 (17%)	32 (44%)	28 (39%)
4. (Has your doctor ever mentioned?)	7 (10%)	65 (90%)	0 (0%)
5. (Have you ever purchased a magnet product?)	4 (6%)	66 (92%)	2 (3%)
6. (Do you believe in magnet therapy?)	24 (33%)	8 (11%)	40 (56%)

Note that the first two questions are out of the total 110 responses, but Questions 4 through 6 are only out of 72 responses: those participants who had heard of magnet therapy. From this table it can be seen that a majority of the survey participants believe in alternative medicine, such as acupuncture. Also, a majority of the people surveyed have heard of magnet therapy. Yet, a majority of the people, who have heard of magnet therapy, would not, or are unsure if they would purchase a magnet therapy product. While almost none of the participants have had their doctor recommend magnet therapy, even fewer have tried the treatment. Finally, of the 72 participants who have heard of magnet therapy, 40 of them are unsure if they believe

in this unproven treatment. While still a large number, 24 already totally believe in magnet therapy. These are very important results: a majority of people surveyed have heard of magnet therapy, while a majority of people who have heard of magnet therapy are unsure if the believe in it.

The next important piece of information is the WPI junior's response to the second part of Question 2, from which source had they heard of magnet therapy. The below table shows the possible sources and the number of responses for each.

Source	Number of Responses
Television commercials	29
Newspaper articles	26
Internet	20
Friend or family member	30
Magazine advertisements	35
News broadcasts	26
Doctor or medical professional	10
Other	17

It can be seen that magazine advertisements are the source from which the most WPI juniors have heard of magnet therapy. Other popular sources are television commercials, news broadcasts, newspaper articles, and friends and family. Clearly, the publicity of magnet therapy has done a good job, making WPI juniors aware of magnet therapy through the different media sources. This data also shows that the survey participants were being decently honest in their answers: 10 people have heard of magnet therapy from their doctors, while 7 people answered Question 4 in the affirmative that their doctor had recommended magnet therapy.

One final piece of information which is useful from the WPI junior survey is the number of people who believe in alternative medicine and also believe in the medical practice of magnet therapy. The bar graph below (Figure 5.1) shows the participants who answered in the affirmative that they believe in alternative medicine and their subsequent answers to the question about their belief in magnet therapy.

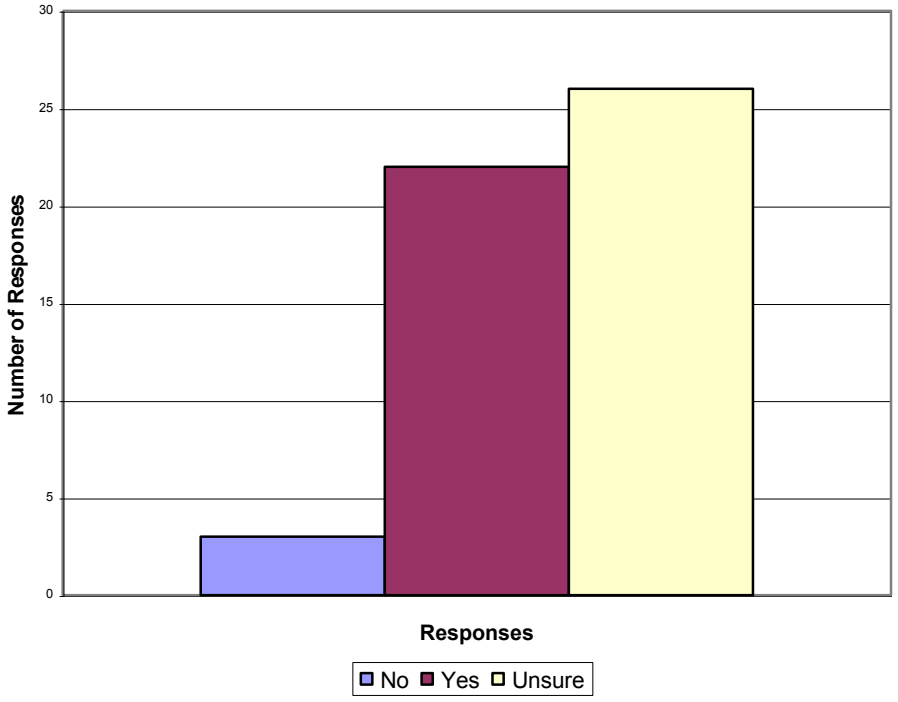


Figure 5.1: Bar graph of WPI junior's who believe in alternative medicine responses to whether they believe in magnet therapy.

As one can see, of the 51 people who believe in alternative medicine and have heard of magnet therapy, a majority are unsure if magnet therapy works. But, still a large number of these 51 people already believe in magnet therapy as a valid form of medical treatment.

In conclusion, the WPI junior class survey showed that 20 year old, college educated people have heard of magnet therapy, but are unsure of their belief in it. It

also showed that these college students have largely heard of magnet therapy through the many media outlets, such as television, magazine advertisements, and on the internet. It should be noted that very limited conclusions can be drawn from the WPI junior class survey, since it only surveyed a single demographic. The shopping mall survey, on the other hand, provides data analysis on the responses by people of different age, income, and education.

5.3 Shopping Mall Survey

In order to determine the American public's opinion of magnet therapy, we would have to conduct a nationwide survey. This is clearly an impossible task for an IQP. A shopping mall survey was decided to be the best hope of gaining a more general representation of the populace's perception of magnet therapy. A shopping mall would hopefully provide a more diverse group of survey participants than the WPI survey: people of different ages, incomes, and education levels. Conducting the survey at nearby shopping malls would be a fairly easy task and would yield very important data. It was decided that this survey would be composed of questions identical to the WPI mail survey, so future conclusions may be made. Upon contacting several nearby shopping malls, it was learned that not all permitted surveys to be conducted on their property. Shopping malls such as the Solomon-Pond Mall in Marlboro, Ma. and the Auburn Mall in Auburn, Ma. simply did not allow surveys to be conducted for various reasons, while malls such as the Greendale Mall in Worcester, Ma. permitted surveys, pending a content review by the mall administration. Copies of the planned survey were faxed to the management office of

the Greendale Mall, and after waiting several weeks the survey was approved by the mall. The Greendale mall had no restrictions as to where the survey booth was set up or what techniques were used to gain participation in the survey. The first date chosen was Saturday the 12th of February, at the Greendale mall, and it was decided that the survey should be setup from 10am until about 3pm. Copies of the survey were made and clipboards were purchased for people to fill out the survey, and candy was purchased to give to the participants upon completion of the survey.

From 10am until about 2pm that Saturday, approximately 200 surveys were administered and completed, which was considered a high level of success. The technique used to gain people's participation in the survey by this IQP group worked very well at this particular location. Group members approached people in the mall, asking them to participate in a student survey, which would take very little of their time. Approximately 30% of the people approached in the Greendale mall were willing to participate in the survey. There were, however, other events occurring at the mall at the same time as the survey, such as a dog show of some sort, which may have led to a lower participation than expected. If the technique of approaching mall patrons was not allowed, very few people may have participated in the survey. In total, 199 surveys were gathered representing the shopping mall survey.

The data provided in these surveys was then analyzed to determine if a vast cross section of the population was represented in the survey and the participant's awareness and belief in magnet therapy. A similar convention as the WPI survey data was adopted: that the responses of those people who had not heard of magnet therapy would be disregarded for questions four through six of the survey (refer to Appendix

B). A similar program was written to input the data collected from the shopping mall survey with the help of Professor Joseph D. Petruccelli and can be seen in Appendix C. The data from the shopping mall surveys could then be analyzed using the statistical software.

One of the first important determinations is the shopping mall participant's responses to the six magnet therapy questions. The below table shows the responses of the shopping mall participants: Yes, No, or Unsure, and percentage of responses to the six survey questions.

Question # (Brief Description)	Yes (%)	No (%)	Unsure (%)
1. (Do you believe in alternative medicine?)	150 (75%)	15 (8%)	34 (17%)
2. (Have you ever heard of magnet therapy?)	129 (65%)	70 (35%)	0 (0%)
3. (Would you purchase a magnet therapy product?)	39 (30%)	43 (33%)	47 (36%)
4. (Has your doctor ever mentioned?)	11 (9%)	116 (90%)	2 (2%)
5. (Have you ever purchased a magnet product?)	23 (18%)	105 (81%)	1 (1%)
6. (Do you believe in magnet therapy?)	51 (40%)	13 (10%)	65 (50%)

Note that the first two questions are out of the total 199 responses, but Questions 4 through 6 are only out of 129 responses: those participants who had heard of magnet therapy. From this table it can be seen that a majority of the survey participants believe in alternative medicine, such as acupuncture. Also, a majority of the people surveyed have heard of magnet therapy. Yet, a majority of the people, who have heard of magnet therapy, would not or are unsure if they would purchase a magnet therapy product. While, only 11 of the participants have had their doctor recommend magnet therapy, more than double that amount have already bought a magnet therapy product. Finally, of the 129 participants who have heard of magnet therapy, 65 of

them are unsure if they believe in this unproven treatment, while still a large number, 51 already totally believe in magnet therapy. These are very important results: a majority of people surveyed had heard of magnet therapy, while a large number of people who had heard of magnet therapy were unsure if they believe in it.

The next source of data is the shopping mall participant's responses to the second part of Question 2, from which source had they heard of magnet therapy. The table below shows the possible sources and the number of responses for each given by the shopping mall participants.

Source	Number of Responses
Television commercials	36
Newspaper articles	34
Internet	18
Friend or family member	61
Magazine advertisements	30
News broadcasts	33
Doctor or medical professional	15
Other	18

It can clearly be seen that, while the WPI junior's main source had been magazine advertisements, the shopping mall patrons had largely heard about magnet therapy through their friends and family, by almost a two-to-one margin over the other sources of information. Secondary to friends and family, shopping mall survey participants had heard of magnet therapy through the usual media sources: television, the newspaper, and magazine advertisements.

Now, where the WPI survey was limited, the shopping mall survey was not: it provides data as to the age, income, and education of each survey participant. The four tables below show the demographic data: race, age, income, and education, and the number of responses for each division within these groups. This will allow the determination of whether a valid cross section of people participated in the shopping mall survey.

Race	# of Responses
White	152 (76%)
Hispanic	20 (10%)
African American	12 (6%)
Asian	12 (6%)
Other	3 (2%)

Age	# of Responses
10-17	24 (12%)
18-24	68 (34%)
25-35	40 (20%)
36-50	42 (21%)
50+	25 (13%)

Income	# of Responses
0-20	71 (36%)
20-40	47 (24%)
40-60	37 (19%)
60-80	21 (11%)
80-100	8 (4%)
100+	15 (8%)

Education	# of Responses
Som_HS	30 (15%)
Com_HS	31 (16%)
Som_Coll	58 (29%)
Com_Coll	38 (19%)
Ph.D.	42 (21%)

Note that the following abbreviations were used in the table and graphs: some high school (Som_HS), completed high school (Com_HS), some college (Som_Coll), and completed college (Com_Coll). It can be seen from these tables that a large majority of the survey participants were white and that there is a good education distribution in

the participants. The number of participant's responses in the different groupings must then be compared to those of the region the survey took place in, to determine if an accurate cross section of the local population was surveyed. Two groupings that can easily be accessed in the 1990 U.S. Census for the city of Worcester are the race and age of its people. The 1990 U.S. Census for the city of Worcester can be accessed online through the internet address:

http://www.magnet.state.ma.us/dhcd/iprofile/348.htm.

The total population of the city, 169759 people, can be seen in the two below tables grouped according to race and age, using the same divisions as in the survey.

1990 Census for Worcester, Massachusetts

Race	# of People	Age	# of People
White	148167 (87%)	10-17	14494 (9%)
Hispanic	15868 (9%)	18-24	25095 (15%)
African American	6770 (4%)	25-35	31553 (19%)
Asian	4323 (3%)	36-50	27885 (16%)
Other	928 (1%)	50+	47362 (29%)

It can be seen that the race of people surveyed at the Greendale mall is a very accurate representation of the people living in the city of Worcester. Clearly an accurate cross section of the population has been surveyed so these shopping mall surveys can now be used to represent the public. However, the ages of survey participants are not distributed in the same way as the people who live in Worcester. It can be seen that a large number of shopping mall survey participants were ages 18-24. This is not

beneficial to the survey analysis and can be understood when the meaning behind these demographics is examined: age most likely dictates income and education. The most visible example of this is that a survey participant who is 10-24 years of age is still in school and makes $0 a year. This is especially true in this survey, where almost half of the participants (92 out of 199) are of age 10-24. This overabundance of youthful participants may throw off the data analysis with respect to income and education. Another potential problem in the data analysis is in the survey question on education, which does not distinguish between a person currently in school and one who has been out of school for sometime. For example, a seventeen year-old high school student would have checked 'some high school', likewise a fifty year-old man who dropped out of high school thirty years ago would have checked 'some high school'. This slight oversight may throw off the data analysis with respect to education, but was not discovered until after the surveys had been administered and completed. Nonetheless, the survey responses must now be analyzed with respect to age, income, and education.

When the first question (Do you believe that alternative medicinal practices, such as acupuncture, are valid forms of medical treatment?) is analyzed with respect to age, income, and education, an interesting tend appears in the income analysis. The below bar graph (Figure 5.2) shows the percent of Yes responses to the total number of responses in each division versus the different division's response to the first question.

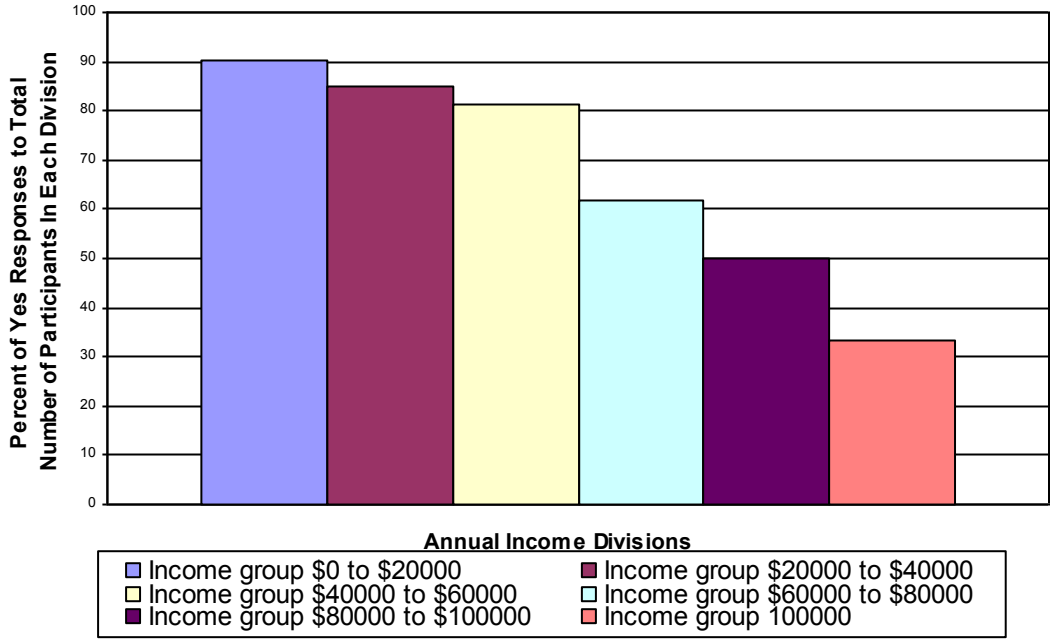


Figure 5.2: Bar graph of the percent of shopping mall participants who believe in alternative medicine over the total number of participants grouped according to their yearly income.

This trend shows a steady decrease in the number of positive responses to Question 1 as yearly income increases. Essentially, the survey participants with a lower yearly income are more likely to believe in alternative medicinal practices.

Question 2 (Have you ever heard of the medical practice of magnet therapy?) is next analyzed with respect to age, income, and education. A clear trend is found in the answers of the participants, based on age. The table below is called a 'two way table'. It is simply a method of presenting data used by many statistical mathematicians for its simple design and readability. This particular table displays the different age groups in rows and the yes/no responses in columns. Therefore, it can show the yes/no responses for each age group all at once, remembering that on the

table, frequency equals the number of responses. In addition, it computes the percentage of responses for each group as well as each row and column total.

HEARD	AGE					
Frequency Percent Row Pct Col Pct	10-17	18-24	25-35	36-50	50+	Total
n	13	34	14	6	3	70
	6.53	17.09	7.04	3.02	1.51	35.18
	18.57	48.57	20.00	8.57	4.29	
	54.17	50.00	35.00	14.29	12.00	
y	11	34	26	36	22	129
	5.53	17.09	13.07	18.09	11.06	64.82
	8.53	26.36	20.16	27.91	17.05	
	45.83	50.00	65.00	85.71	88.00	
Total	24	68	40	42	25	199
	12.06	34.17	20.10	21.11	12.56	100.00

This table shows that there are 107 participants age 25-50+, and of them 23 (21%) had not heard of magnet therapy, while 84 (79%) had heard of magnet therapy. It also shows that of the 70 participants who had not heard of magnet therapy, 47 (67%) were age 10-24. Essentially, a majority of the younger participants had not heard of magnet therapy, while a majority of the older participants had heard of magnet therapy.

The second part of Question 2 (From which of the following sources have you heard of magnet therapy?) can now be analyzed by age, income, and education. An interesting anomaly is seen when the ‘internet’ source is analyzed by age. 11 of the 18 responses to the source: internet were given by participants age 18-24, that’s 61% of the responses! Clearly the younger survey participants are finding more internet advertisements and websites. The ‘friend or family member’ source shows an interesting result when analyzed with respect to age. Of the 61 responses to that source, 31 (51%) were given by participants age 36-50+. Clearly elder survey

participants are learning about magnet therapy through their friends or family. Finally, useful information is produced when the source 'doctor or medical professional' is analyzed with respect to education. Figure 5.3 shows the number of survey participants who had heard about magnet therapy from their doctor or medical professional versus the different education groups.

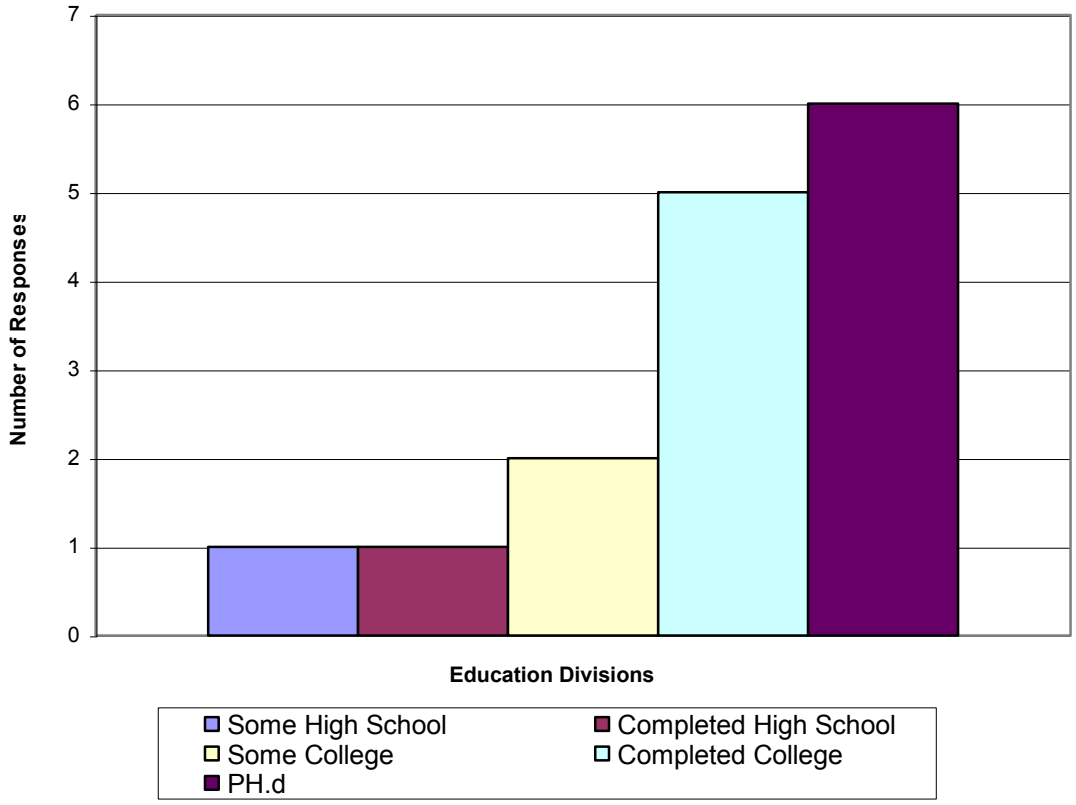


Figure 5.3: Bar graph of participants who have heard of magnet therapy from their doctor or medical professional grouped by education level.

It can clearly be seen that of the 15 responses to this source, 11 (73%) come from survey participants who have completed college or have their Ph.D. Evidently, the more educated shopping mall patrons have heard of magnet therapy from their doctor.

The third question (Would you purchase a magnet therapy product?) was then analyzed with respect to age, income, and education. No trends or anomalies were

found in this analyzed data, the responses of the shopping mall participants were evenly distributed with respect to age, income, and education.

The fourth question (Has your doctor or medical professional ever mentioned or recommended magnet therapy?) was then analyzed with respect to age, income, and education of survey participants, and an anomaly was seen in the age analysis. The below bar graph (Figure 5.4) shows the number of affirmative answers to this question versus the different age divisions.

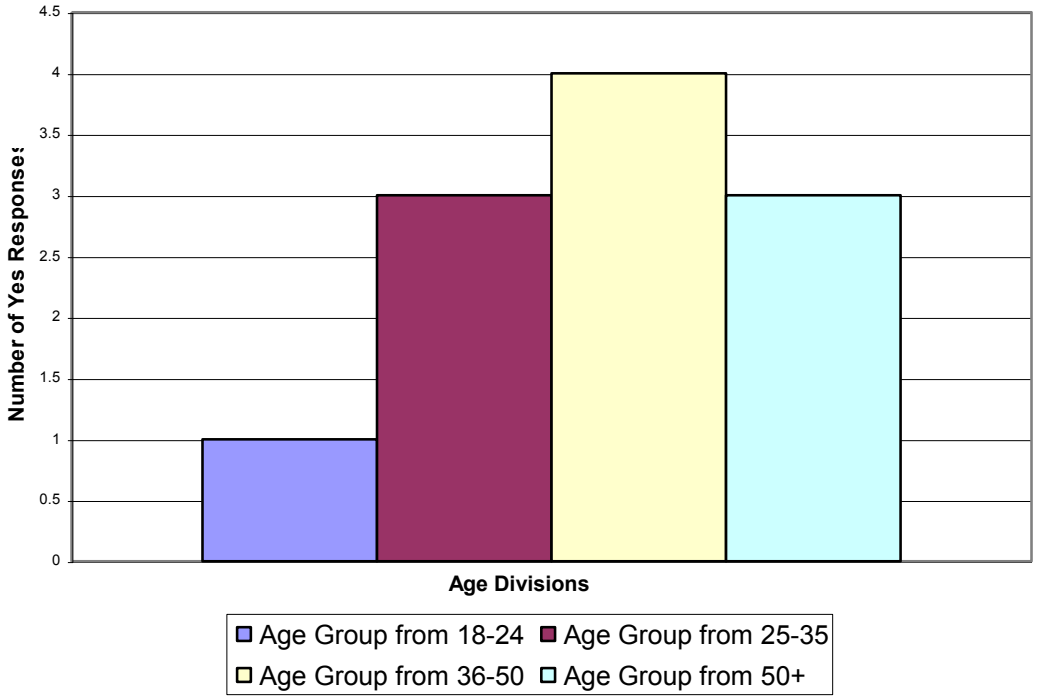


Figure 5.4: Bar graph of survey participants whose doctors or medical professionals have recommended magnet therapy grouped by age.

This graph clearly shows that the majority of participants whose doctors have recommended magnet therapy are age 36-50+. Essentially, the older survey participants are more likely to have been recommended magnet therapy by their doctors.

The fifth question (Have your ever purchased a magnet therapy product?) also produced a similar result as Question 4, when analyzed with respect to age. Figure 5.5 shows the percent of 'Yes' responses to Question 5 over the total number of responses for each division versus the different age groups.

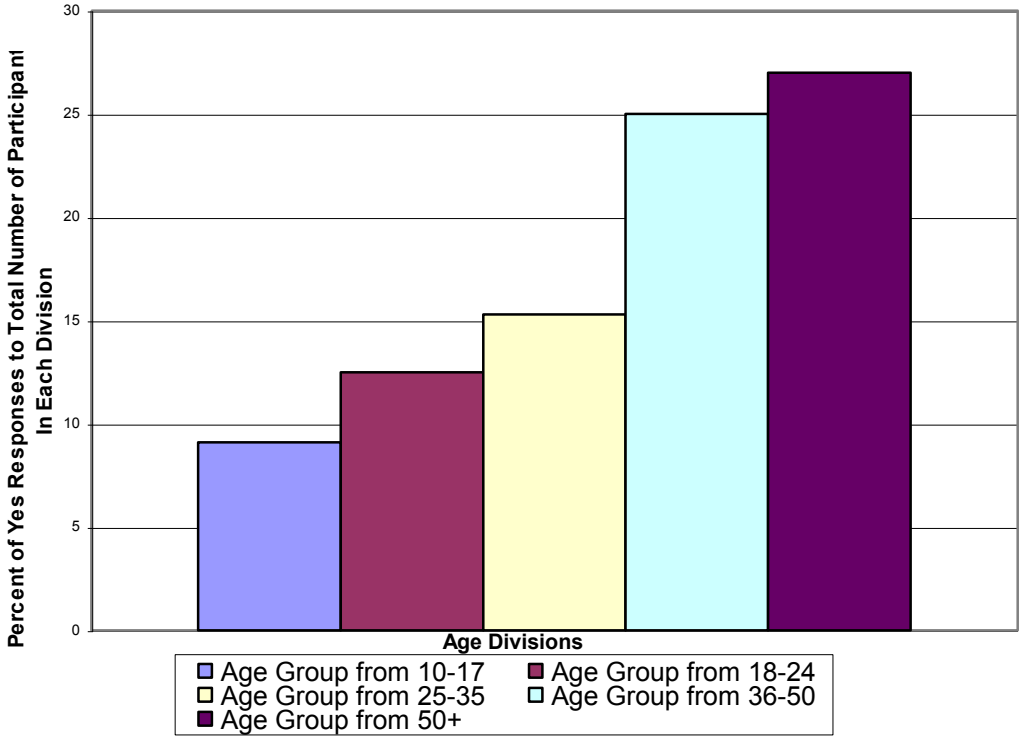


Figure 5.5: Bar graph of percent of affirmative answers to Question 5 over total number of responses versus the different age groups.

This bar graph clearly shows that more, older, survey participants have already purchased magnet therapy devices.

The sixth and final magnet therapy question (Do you believe magnet therapy is a valid form of medical treatment?) can now be analyzed with respect to age, income, and education. A clear trend is seen in the income analysis and is displayed in Figure

5.6 of participants who answered in the affirmative to Question 6 over total number of participants versus the different income groups.

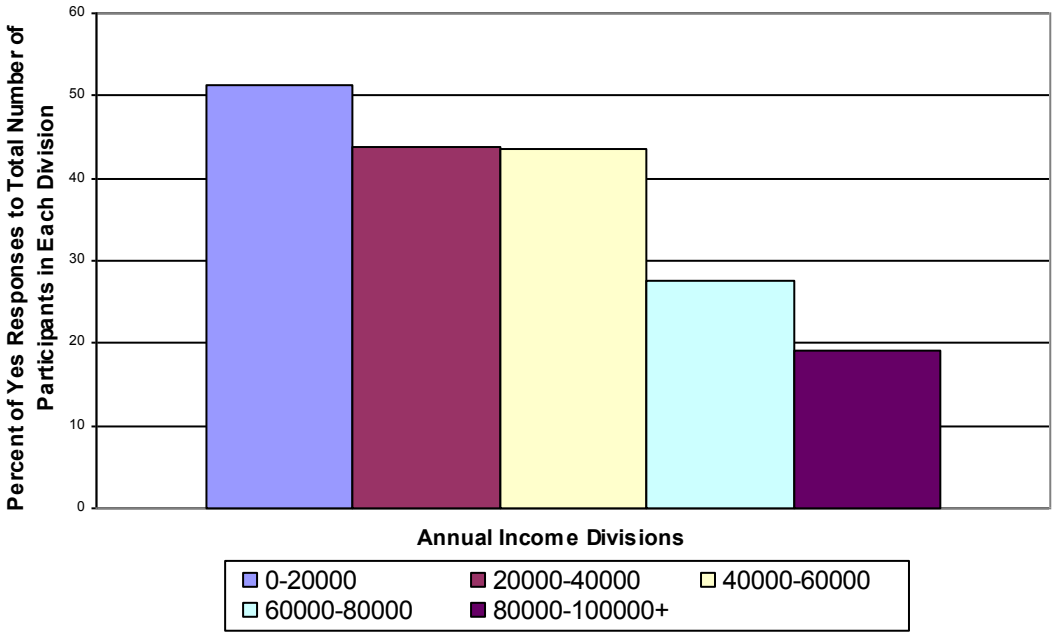


Figure 5.6: Bar graph of percent of 'Yes' responses as to whether the participants believe in magnet therapy over total number of responses grouped according to income.

This bar graph shows that survey participants with a lower yearly income are more likely to believe in magnet therapy. This is a very similar trend to the one found in the analysis of Question 1, whether or not participants believe in alternative medicine. In both cases, Figure 5.2 and Figure 5.6, shopping mall participants with a lower yearly income were more likely to believe in alternative medicines, such as acupuncture, or magnet therapy.

In conclusion, it is obvious that the shopping mall survey has produced very useful and important data in determining the public's awareness and belief in magnet therapy. This survey provided a decent cross-section of the population of Worcester,

Massachusetts with respect to the participant's race. Analysis showed that a positive belief in both alternative medicine, such as acupuncture, and magnet therapy, was directly related to yearly income. Essentially, the lower the yearly income, the more likely that person is to believe in alternative forms of medical treatment. Also, the older survey participants were more likely to have been recommended magnet therapy by their doctors and were more likely to have already purchased a magnet therapy product. Finally, within the shopping mall participants, a majority of the younger participants had not heard of magnet therapy, while a majority of older participants had heard of magnet therapy. In this case younger survey participants were unaware of magnet therapy, while older participants were. The results of the shopping mall survey show its success in the analysis of the public's awareness and belief in magnet therapy based on age, income, and education.

5.4 Magnet Therapy Publicity

One of the main factors in the public's awareness of a product is the advertising and publicity of said product. Companies use advertisements and articles in newspapers and magazines, commercials and infomercials on television, and more recently the internet to inform the public of their products. For this reason, examining the advertisements and publicity of the magnet therapy industry is essential in determining the public's awareness and belief in magnet therapy. If the companies selling magnet therapy products have large advertising campaigns and utilize the many different forms of advertising, the public will be well informed about magnet therapy. Advertisements and articles in magazines and newspapers will be analyzed, in

addition to commercials and infomercials on television, and internet websites in an attempt to determine the magnet therapy industry's advertising campaign. Another important consideration is whether or not magnet therapy companies are advertising in such a way as to target a specific group of people. The companies may be advertising to a specific age group, income level, or lifestyle of people, in hopes that they would be more inclined to purchase magnet therapy products.

Many different articles in both newspapers and magazines were found during this IQP, all dealing with magnet therapy. In almost all of the newspapers, magnet therapy articles were found in their respective Health or Medicine sections. Newspapers, such as *The Los Angeles Times, The New York Times*, and *The San Diego Union Tribune*, all spoke of the growing popularity of magnet therapy and recent medical studies involving it. In particular, almost all of the articles found made reference to the double-blind study conducted by Dr. Carlos Vallbona. These articles all referred to the Vallbona study as inconclusive and said that more studies needed to be conducted before magnet therapy is conclusively proven. Not many magazine articles were found involving magnet therapy. However, those that were found were located in Health/Fitness magazines for young adults. Magazine articles from such magazines as *Shape*, gave a small explanation of the science behind magnet therapy and investigated some of the claims of magnet therapy retailers. These articles all go on to say that further study must be done before magnet therapy is widely accepted by the medical community. Magazine articles such as these are simply interested in presenting the facts on magnet therapy to the readers and are unbiased in this regard.

Every company uses advertisements to sell their products to the public. For this reason, magnet therapy advertisements are very easy to find in newspapers, magazines, flyers, and even contained within credit card bills. Advertisements were found in several newspapers, but did not go into any kind of detail on the magnet therapy products. They all simply gave a small summary of magnet therapy and its healing abilities and a telephone number to call for those who were interested in purchasing magnet therapy products. Several advertisements were found in shopping flyers or in other sources one would not think to look for magnet therapy advertisements, such as in a credit card bill. These ads, for instance one in a shopping flyer for Walgreens pharmacy, offered several different magnet therapy products, supplying the price and several pictures of the device, and sometimes even a coupon. Advertisements along this line would sometimes give the phone number of the company to call and place an order. By far a majority of advertisements for magnet therapy products were found in magazines. In particular, fitness and sports magazines contained several magnet therapy ads. These magazines, produced for athletes, are common advertising forums for magnet therapy, since magnet therapy's main use is in the reduction of pain and athletes experience more pain than the average person. Figure 5.7 is an example of a common type of magnet therapy advertisement and was received by almost all of the IQP group members in their credit card bills.

Figure 5.7: Magnet Therapy Advertisement

Advertisements, such as this, all show a picture of the magnet therapy product, its price, and a small statement about magnet therapy. These many advertisements in magazines, newspapers, and flyers, all encourage the consumers to 'Discover the Magic of Magnet Therapy.'

Magnet therapy companies are also using two very popular information sources, television and the internet, to entice consumers. Television provides retailers a cheap method to reach millions of Americans wanting to buy new merchandise. Magnet therapy product commercials have been seen at night and during morning television programs. These short commercials almost always have a celebrity endorsing the magnet therapy products, such as golfer Chi Chi Rodriguez. They give a brief explanation of the science behind the magnets and then the price and phone number or address of the company so an order can be placed. One of the latest commercials, currently running in prime-time television, is by Dr. Scholl's, the foot-

pad manufacturer. This ad publicizes a new line of magnetic shoe inserts, and simply tells customers to look for them in stores now. Only several of these commercials were observed during this IQP. Television also informs the public on recent developments in magnet therapy research. News broadcasts sometimes feature quick two-minute stories on magnet therapy. These stories start by mentioning the growing popularity of magnet therapy, giving a number on the yearly business. They then go on to talk about the latest medical study involving magnet therapy, such as the case with the latest article in the Journal of the American Medical Association (JAMA). The fact that magnet therapy is regularly featured in news reports and in news magazine stories reflects the growing popularity and awareness of magnet therapy. Another new source of information for the public is the internet. When one goes to yahoo.com and enters the query 'magnet therapy' more than 100 websites for companies selling magnet therapy products are found. These websites all provide news and information on magnet therapy, but more importantly, since they are owned and updated by magnet therapy retailers and distributors, they are trying to persuade customers to by their products over the internet. Magnet therapy retailers are hoping, like many companies, to significantly increase their profit through internet business.

Clearly, magnet therapy publicity is everywhere. Articles in newspapers and magazines as well as news broadcasts on television educate and inform the public to the technology and advances in magnet therapy. Advertisements in newspapers, magazines, and on television, and now the internet are bombarding consumers with the idea of magnet therapy. These outlets allow customers to purchase magnet therapy

products from more sources than ever before. The publicity divisions of the magnet therapy industry have been working hard to inform and entice the American consumer.

5.5 Conclusions

The WPI junior class survey and the Greendale shopping mall survey that were conducted provided vital information on the public's awareness and belief in magnet therapy. This information combined with research on magnet therapy publicity and advertisement allow a detailed view of the public's perception of this ancient treatment. The WPI junior class survey along with part of the shopping mall survey show that 20 year-old, college educated people have heard of magnet therapy through the many different media outlets. In addition, young, athletic people have many forms of magnet therapy publicity presented to them in the form of magazine articles and advertisements. This is most likely due to the fact that athletes and people who play sports are more inclined to pain and injuries, and might therefore be open to new and different methods of treatment. This is most likely the reason that magnet therapy companies have sports celebrities endorse their products: athletes are more apt to believe other professional athletes. The shopping mall survey has shown that older survey participants have mainly heard of magnet therapy through their doctors or friends and family. Some older participants have already purchased magnet therapy products. The main explanation for this information is that older people have been dealing with the pains of aging for several years and continue to learn about and try new forms of treatment. The shopping mall survey also produced interesting results in respect to a participant's yearly income and belief in alternative medicines. The data

showed that people with less yearly income were more likely to believe in both previously accepted forms of alternative medicine, such as acupuncture, as well as magnet therapy. Altogether, the two surveys produced results essential in gauging the public awareness and belief in magnet therapy. The surveys showed that a majority of people are aware of magnet therapy, yet are unsure if they believe in this unproven treatment.

This is what every single piece of evidence and data have been saying about magnet therapy: that further study is needed. Every newspaper and magazine article and analysis of magnet therapy technology, both skeptics and proponents of magnet therapy, all conclude that more studies and experimentation must be conducted before a final conclusion is reached. This is where the comparison between acupuncture and magnet therapy is useful. Today, acupuncture is widely accepted by both the medical community and the public as a result of numerous clinical studies. Acupuncture is conceptually very similar to magnet therapy, they both deal with a re-balancing of life-energies at certain points in the human body. However, unlike magnet therapy, acupuncture has been FDA approved and even a growing number of insurance companies will pay for acupuncture treatment. Acupuncture's clear establishment as a medical practice may also be linked to the fact that skilled practitioners must administer the treatments. Yet, in the case of magnet therapy, magnets may be purchased and used at home, without ever consulting a physician. Magnet therapy must be further tested and may have to be physician licensed before it is recognized as a valid form of medical treatment by the American public.

In essence, the publicity and advertisement of magnet therapy has made the American public more aware of this medical practice, but further studies and tests will be necessary to prove to them that it really works.

Chapter 6: Conclusions

Although magnet therapy is a medical practice that has existed for several thousand years, it continues to be surrounded by controversy. The magnet therapy business has been steadily growing for the last ten years due to people's renewed interest in natural holistic medicines. Recent advances in technology have allowed the production of cheaper, stronger magnets giving fuel to magnet therapy proponent's claims. Today, infomercials and magazine advertisements, replete with celebrity endorsements, are trying to sell the public another form of alternative medicine. However, conclusive medical studies and scientific proof are lacking for this form of treatment. The public's view on magnet therapy is also important since they dictate the market for these products. These aspects of technology and society were presented in this IQP.

Of the handful of medical studies currently available, several claim magnet therapy works, while several do not. These are very conflicting results. Several of the studies claim a decrease in pain amongst the groups that received actual magnetic devices, however, other studies do not have the same findings. The most popular and talked about medical study of magnet therapy, published by Dr. Carlos Vallbona, concludes that magnet therapy is effective in reducing patients' pain. However, the most recent study on magnet therapy, published in the highly reputable JAMA, compares itself to the Vallbona study, yet concludes that magnet therapy is ineffective. This is a prime example of the conflicting nature of medical studies dealing with magnet therapy. Several of the studies were very hard to come across and were found in obscure or low quality medical journals. In the most flagrant case, doctors, who

own part of a magnet therapy company, have been conducting studies on their own devices. These people obviously have something to gain from the publication of medical reports verifying the success of a product they own. Certainly, further studies need to be conducted and analyzed before magnet therapy is conclusively proven to work.

The physics behind magnet therapy is essential in understanding the popularity of the practice. Recently, new materials, such as Neodymium, have revolutionized the practice of magnet therapy. These new materials have made strong permanent magnets available to the public, where years ago they were unheard of, even in research labs. Thus, scientific research has allowed the commercialization of strong magnets and, as a result, made magnet therapy more affordable. However, even with more powerful magnets, the functioning of these devices is still a complete mystery to scientists. Two of the main theories put forth as to the function of magnet therapy are that it increases blood flow or that it blocks pain receptors in the effected area. However, no definite proof or concrete physical explanations as to the mechanism for the effects of magnet therapy have been found. Basic physics shows that the magnet's effects on ions in the blood and associated with nerve cells are minute and would never cause a measurable change in their behavior. Essentially, there is no physical explanation for why magnet therapy might work.

In the 1800's the public believed foolhardily in the magnetic products and claims of Franz Anton Mesmer. The public has changed greatly in the last 200 years and the WPI and shopping mall surveys show that a majority of people are unsure whether or not they believe in magnet therapy. These surveys also show that even if

people are unsure of magnet therapy as a valid form of treatment, a large majority have heard of this holistic practice. The publicity and advertising utilized by the magnet therapy companies are largely responsible for many Americans' awareness of the technology. Advertisements in newspapers and magazines, commercials on television, books, and even the internet have expanded the market size for many magnet therapy retailers. The majority of books currently available on magnet therapy do not present any scientific proof or medical evidence, the only evidence they offer the public is success stories of doctors, regular people, and celebrities. Since the alleviation of pain is one of the main selling points of magnet therapy, these advertisements and books are mainly targeted at those people who constantly deal with pain in their daily lives: mostly athletes and the elderly. The views of the public are essential to the further success of magnet therapy in America. However, at the present time it seems that the only evidence offered to a scientifically 'illiterate' public, success stories, is enough to convince them of magnet therapy's validity and generate a market of hundreds of millions of dollars.

Finally, the involvement of important government agencies and scientific bodies with magnet therapy is lending credibility to this growing practice. The FDA has begun to monitor magnet therapy's advertisement and devices. The NIH has begun to fund studies testing the validity of magnet therapy in reducing pain. The *Journal of the American Medical Association* has recently published a medical study dealing with magnet therapy. The NIH has approximately a $16 billion yearly budget and is a trusted agency within the scientific and medical communities. Clearly, their funding of a scientific study on magnet therapy gives credibility to the growing belief

in magnet therapy. A scientifically 'illiterate' public sees the NIH and JAMA working on magnet therapy and no matter the outcome of the studies will cause Americans to continue buy into the fad of magnet therapy.

This IQP combined the aspect of technology and society in the examination of magnet therapy. The current medical studies were looked at as well as the physical theories behind the functioning of magnetic devices. On society's side, the public's awareness and belief in magnet therapy were gauged through two surveys. The magnet therapy industry itself was examined from its advertising and publicity to its business practices and FDA approval.

Further IQP groups wishing to deal with magnet therapy may attempt to interview doctors or medical professionals and patients who have tried magnet therapy. This would provide the view of magnet therapy from people in the medical field as well as patients' successes or failures with the technology. An MQP could also be conducted to test the strength of the various magnet therapy products and determine a working theory as to their function.

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Appendix A: WPI Junior Class Survey
Magnet Therapy Survey

As students at Worcester Polytechnic Institute we must complete an Interactive Qualifying Project in order to graduate. The Interactive Qualifying Project (IQP) challenges students to identify, investigate, and report on a self-selected topic examining how science or technology interacts with social structures and values. Our IQP deals with the growing popularity of magnet therapy. To this end, we are attempting to determine the public's awareness and belief in this growing medical practice. Your answers to the following questions are pivotal to the success of this project and will of course remain confidential. Please take 3-4 minutes to fill out this survey. Once completed, please refold this paper so the return address is shown and tape or staple it together. Please return by February 10, 2000. Thank you for your time.

1. Do you believe that alternative medicinal practices, such as acupuncture, are valid forms of medical treatment? Yes No Unsure

2. Have you ever heard of the medical practice of magnet therapy? Yes No Unsure

If yes, then from which of the following sources have you heard of magnet therapy? (Check all that Apply)

_____television commercials
_____magazine advertisements
_____newspaper articles
_____news broadcasts
_____internet
_____doctor or medical professional
_____friend or family member
_____other

3. Would you purchase a magnet therapy product? Yes No Unsure

4. Has your doctor or medical professional ever mentioned or recommended magnet therapy? Yes No Unsure

5. Have you ever purchased a magnet therapy product? Yes No Unsure

6. Do you believe magnet therapy is a valid form of medical treatment? Yes No Unsure

7. Sex: ____Male ____Female

8. Race:
_____Native American/Indian
_____African American, not of Hispanic origin
_____Asian/Pacific Islander
_____Hispanic
_____White
_____Other

9. Age:
___10-17 ____18-24 ____25-35 ____36-50 ____50+

10. Income:
____$0 - $20,000
____$20,000 - $40,000
____$40,000 - $60,000
____$60,000 - $80,000
____$80,000 - $100,000
____$100,000+

11. Education:
_____Some High School
_____Completed High School
_____Some College / Some Trade
_____Completed College / Completed Trade
_____Masters or Ph.D.

Once completed, please refold this paper so the return address is shown and tape or staple it together.
Please return by February 10, 2000.

Jay Corporon, Melissa Michelon, Tony Cruz, & Matt Hirsch
Thank you.

Appendix B: Shopping Mall Survey

Magnet Therapy Survey

As students at Worcester Polytechnic Institute we must complete an Interactive Qualifying Project in order to graduate. The Interactive Qualifying Project (IQP) challenges students to identify, investigate, and report on a self-selected topic examining how science or technology interacts with social structures and values. Our IQP deals with the growing popularity of magnet therapy. To this end, we are attempting to determine the public's awareness and belief in this growing medical practice. Your answers to the following questions are pivotal to the success of this project and will of course remain confidential. Please take 3-4 minutes to fill out this survey. Once completed, please fold this paper and place in designated box. Thank you for your time.

1. Do you believe that alternative medicinal practices, such as acupuncture, are valid forms of medical treatment? Yes No Unsure

2. Have you ever heard of the medical practice of magnet therapy? Yes No Unsure

If yes, then from which of the following sources have you heard of magnet therapy? (Check all that Apply)

_____television commercials
_____magazine advertisements
_____newspaper articles
_____news broadcasts
_____internet
_____doctor or medical professional
_____friend or family member
_____other_____

3. Would you purchase a magnet therapy product? Yes No Unsure

4. Has your doctor or medical professional ever mentioned or recommended magnet therapy? Yes No Unsure

5. Have you ever purchased a magnet therapy product? Yes No Unsure

6. Do you believe magnet therapy is a valid form of medical treatment? Yes No Unsure

7. Sex: ____Male ____Female

8. Race:
_____Native American/Indian
_____African American, not of Hispanic origin
_____Asian/Pacific Islander
_____Hispanic/Latino
_____White
_____Other

9. Age:
___10-17 ____18-24 ____25-35 ____36-50 ____50+

10. Income:
____$0 - $20,000
____$20,000 - $40,000
____$40,000 - $60,000
____$60,000 - $80,000
____$80,000 - $100,000
____$100,000+

11. Education:
_____Some High School
_____Completed High School
_____Some College / Some Trade
_____Completed College / Completed Trade
_____Masters or Ph.D.

Once completed, please fold this paper and place in designated box.

Jay Corporon, Melissa Michelon, Tony Cruz, & Matt Hirsch
Thank you.

Appendix C: Inputting Survey Data

Professor Joseph D. Petruccelli of the WPI Mathematical Sciences Department was then consulted to aid in the use of the statistical software and the inputting of data. With his help a program was constructed to input the survey data. This program consisted of three lines of code labeling the variables, in this case the different survey questions, followed by the data from each survey. For the first two questions, yes, no, or unsure was typed into a text editor as a response to each question. For the second part of Question 2, yes or a period '.' was entered: yes if the person had heard of the specific source and '.', representing no data entered, if they had not. For the remaining four magnet therapy questions, yes, no or unsure were inputted depending on each participants response. The seventh question was inputted as 'm" if the participants were male and 'f' if they were female. Question 8's data was entered as white (White), hisp (Hispanic), afr (African American), nat (Native American), asi (Asian), or other (Other). The ages were then inputted by the different groupings on the survey: 10-17, 18-24, 25-35, 36-50, 50+. Next, the different annual incomes were entered: 0-20 ($0-$20,000), 20-40 ($20,000-$40,000), 40-60 ($40,000-$60,000), 60-80 ($60,000-$80,000), 80-100 ($80,000-$100,000), and 100+ ($100,000+). Finally the education level of the participants was entered: som_hs (Some High School), com_hs (Completed High School), som_coll (Some College/ Some Trade), com_coll (Completed College/ Completed Trade), and phd (Masters or Ph.D.). The text program and some sample data can be seen below.

```
data sasuser.msurvey;
input alt $ heard $ tv $ paper $ internet $ friend $ ads $ news $ doctor $ other $ would $ mention $ have $ believe $ sex $ race $ age $
income $ educate $ @@;
cards;
unsure      v     v     v blank     v     v     v blank blank      n      n      n unsure f white 36-50 100+ phd
     v      v     v blank blank blank     v blank blank blank unsure      n      n      v f asi   18-24 0-20 phd
     v      v blank blank blank     v blank blank blank blank      n      n      n unsure f asi   36-50 40-60 phd
     v      v     v     v     v blank     v blank blank blank unsure      n      n      n m white 18-24 0-20 com hs
     v      v blank     v blank     v blank blank blank blank      n      n      n unsure m white 50+   40-60 phd
     n      n     .     .     .     .     .     .     .     . unsure      n      n      n m hisp  25-35 20-40 som coll
     n      n     .     .     .     .     .     .     .     .      n      n      n      n f white 18-24 20-40 com coll
;
run;
```

This text program was then submitted into the Statistical Analysis Software (SAS). Once the data was submitted, clicking on interactive data analysis would bring up a spreadsheet displaying all of the answers to all of the survey questions. The software would then allow histograms (bar graphs) to be plotted based on the response to each question or the response to several questions. For instance, it could plot the Yes/No/Unsure answers to Question 2, based on those participants who answered Yes to Question 1. A special program was used in SAS, written by the Mathematical Sciences department, to generate a 'two way table' for the survey data. The statistical software was essential in the analysis of the WPI junior and the shopping mall survey results.