Effects of Cardiovascular Conditions on

Mortality among Scuba Divers

by

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ABSTRACT

The purpose of this case-control study was to examine the physical fitness level and medical status of active divers and examine the relationship between cardiovascular health conditions and mortality while scuba diving. The secondary purpose of this study was to determine the extent to which those divers who do have preexisting heart conditions perceive their risk of dying while diving and to determine the extent to which they are willing to change their diving behaviors. Data for the live controls in this study were collected from 192 scuba divers using the Scuba Survey Version 3. All divers were members of ScubaBoard, an online scuba diving forum. Data collected included demographic and background information as well as information from the Scuba Survey Version 3. Data for 68 deceased cases were collected using archived data from the Diver's Alert Network Annual Report. The information collected on the cases included age, gender, Body Mass Index, preexisting medical conditions, and cause of death.

Logistic regression was used for the data analysis. The logistic regression models were adjusted to account for potential confounding factors. Statistical analysis were conducted using SPSS Version 20. The classification analysis goal was to produce a model in which 80% of the observed deaths or survival while participating in scuba diving activities, the perceived chance of dying while diving among active divers, and the extent to which divers will stop diving when cardiovascular health condition exist, are correctly predicted.

Divers with fewer dives were more likely to alter their diving behavior by not diving when preexisting cardiovascular conditions exist than the divers who had a higher number of dives per year. This result was not surprising although shows the need to provide additional information to those who are already certified.

Overall, the results of this study helped to answer questions about a diver's perceived chance of dying and willingness to stop diving. The results show a need for future studies and health interventions among scuba divers to educate them about the risks of diving with cardiovascular health conditions.

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CHAPTER I

INTRODUCTION

SCUBA (Self-Contained Underwater Breathing Apparatus) was originally an acronym used to describe the equipment issued to the United States combat frogmen's oxygen rebreathers. The term was used in 1952 by Major Christian Labersten, who served in the U.S Army Medical Corps as a physician and developed rebreathers for underwater combat (Vann, 2007). According to the Oxford English Dictionary, SCUBA can be used as the original acronym or since 1982 can be used as the noun, scuba.

In 1943, Jacques-Yves Cousteau and Emile Gagnan developed and tested the first Aqua-Lung. The design of the Aqua-Lung was a tremendous improvement compared to earlier scuba devices and over the following 10 years completely changed sport diving. With sales of the Aqua-Lung increasing across the United States, diving associations were beginning to develop as well as several publications on the sport. Although the sport of scuba diving was beginning to take form, it was not until 1958 when *Sea Hunt*, a television show starring Lloyd Bridges, brought an unprecedented number of new divers to the sport (Northwest Diving History Association, 2012).

As the manufacturing and advancement of equipment continued, a wide interest in scuba diving continued to develop in the United States. In 1954, a group of YMCA, American Red Cross and National Academy of Sciences professionals turned to the Council for National Cooperation in Aquatics to evaluate the safety of recreational scuba diving. After five years of planning, the YMCA organized and implemented the first national scuba diving course in the United States (Graver, 2003). Throughout the next decade, numerous scuba training agencies followed in the footsteps of the YMCA scuba program. With the increase in the number of divers came an increase in the number of dive accidents.

In 1977, the Undersea Medical Society announced the idea of a national organization where a diver could make a single telephone call from anywhere and could be connected to a diving medicine specialist 24 hours a day. In 1981, after receiving a two-year grant from the National Oceanic and Atmospheric Administration (NOAA) and the National Institute for Occupational Safety and Health (NIOSH), Dr. Peter Bennett formed the National Diving Accident Network which was later changed to Diver's Alert Network (DAN), based out of Duke University Medical Center. The original purpose was to handle questions from recreational divers about medical issues related to scuba diving. Today, Diver's Alert Network's mission is to help divers in need of medical emergency assistance and to promote dive safety through research, education, products and diving services (Diver's Alert Network, 2012). For this study, archived data from DAN was used relating to the deaths of sixty-eight divers.

It has been reported that approximately 138 people die each year while scuba diving worldwide (Diver's Alert Network, 2008). Although recreational scuba diving deaths rarely occur, the risks are significant and awareness of these risks is required to keep deaths as low as possible. Diver's Alert Network has operated and maintained a recreational diving fatality surveillance system since 1989 in order to analyze scuba related accidents which result in fatalities (Vann, 2007). In addition to the cause of death, Diver's Alert Network studies events leading up to an accident and draws conclusions as to how other accidents with similar conditions may be prevented.

Diving is a recreational activity that can be enjoyed for many years. Certification to dive does not expire and there are no minimal requirements to keep a certification valid, even though as individuals age they tend to acquire various health conditions. It is the diver's responsibility to ensure whether he or she is ready to dive. This requires having good physical and psychological fitness as well as staying updated on changing trends and standards (Bennett, Cronje, & Campbell, 2006). Many conditions change over time, which puts the responsibility on each individual diver to self-evaluate his or her readiness and ability prior to each dive. Divers should have an annual medical exam and exercise regularly in order to be prepared to dive.

Although Diver's Alert Network has collected data for many years on diving accidents, injuries, and deaths, little is known of the physical fitness levels and the current medical status of the typical recreational diver (Pollock, 2007). By collecting data on the current fitness level and medical status of active recreational divers we hope to correlate this information to the risk of mortality when diving with pre-existing cardiovascular conditions.

Purpose Statement

The purpose of this case-control study was to examine the physical activity levels and medical status of active divers and to examine the relationship between cardiovascular health conditions and obesity on mortality while scuba diving. The dependent variable in this study is whether or not a person died while scuba diving. The independent variables are cardiovascular health risks, including physical activity level, previous heart and/or blood vessel surgery, high blood pressure, previous heart attack and family history of heart disease. Control variables include age, gender, and Body Mass Index (BMI). The secondary purposes of this study were to determine the extent to which divers perceive that their risk of dying while Scuba diving is related to preexisting heart conditions and obesity. We also examine the extent to which they are willing to change their diving behaviors based on their health.

Research Questions

1. When controlling for age and gender what effects do cardiovascular health conditions and obesity have on the likelihood of dying while participating in scuba diving activities?
2. When controlling for age and gender, what effects do cardiovascular health risks and obesity have on the divers' perception of their likelihood of dying while participating in scuba activities?
3. When controlling for age and gender, to what extent will divers alter their diving behaviors when they learn from their doctors that preexisting cardiovascular conditions and obesity may put them at risk of dying while engaging in Scuba activities?

Hypotheses

1. The more cardiovascular conditions that divers have, and the higher their BMI is, the more likely it is that they will die while participating in scuba diving activities. We will control for age and gender.

2. Divers with pre-existing cardiovascular health conditions perceive their chances of dying while participating in scuba diving activities to be higher than those without preexisting cardiovascular heart conditions.

3. Divers who are told by a physician to stop participating in scuba diving activities are more likely to stop diving than divers whose physician does not tell them to stop participating in scuba diving activities.

Assumptions

1. It is assumed that all controls in this study answered survey questions to the best of their ability and were honest with their answers.

2. It is also assumed that archived data retrieved from Diver's Alert Network are accurate.

Delimitations

1. Data for divers who are alive were only collected from divers who are members of the ScubaBoard online scuba forum.

2. Data for divers who died were abstracted from reports issued through Diver's Alert Network (DAN).

Limitations

1. The demographic and social characteristics of members of the ScubaBoard forum may be different than those who died, including scuba certification status.

2. Mortality records were collected from DAN's archived data.

3. Not all deaths from diving were recorded in DAN's data.

Significance of the Study

This study was conducted to determine the odds of dying while scuba diving when cardiovascular health conditions exist. Deaths while scuba diving were compared between those who had or did not have preexisting cardiovascular health conditions. In addition to determining the cardiovascular health status of active divers, willingness to change diving behavior associated with these risks were assessed. Given an association between cardiovascular health risk factors and scuba deaths, education and training changes would be warranted to better educate the divers on the dangers associated with poor cardiovascular health.

CHAPTER II

LITERATURE REVIEW

Unlike early diving, which relied exclusively on air pumped from the surface, scuba diving involves a diver carrying specialized equipment from which to breathe underwater for recreational, commercial, or industrial reasons (U.S. Department of the Navy, 2008). According to the Diving Equipment Marketing Association (DEMA) there are approximately 1.5 million active scuba divers in the United States. The dive industry is non-regulated, therefore scuba agencies do not share information with the public or each other on the number of divers certified each year. The actual number of active divers is not an official figure but an approximation. There is also no consensus on a definition of what is considered an active diver. For the purposes of this paper, an active diver will be defined as someone who dives five or more times per year (Davidson, 2011).

Scuba diving is a technical sport in which training and certification are required. People cannot rent or buy scuba gear, get their cylinders filled with air, or dive through a dive center without a valid certification card (C-Card). Individuals wishing to participate in scuba diving must successfully complete an open water scuba diving course and complete all requirements for certification. Those wishing to participate in scuba diving must also complete medical questionnaires prior to each course. The purpose of the questionnaire is to screen for health conditions which may be contraindications to diving. Information provided by Diver’s Alert Network has been beneficial to various scuba agencies in the development of questionnaires.

Diver’s Alert Network

Diver’s Alert Network has been providing medical services to scuba divers all over the world for the past three decades. These services include handling over 200,000 calls for medical information and 50,000 calls to the emergency hotline. Diver’s Alert Network has trained 210,000 providers, 15,000 instructors and 3,000 physicians in diving related courses, in keeping with their mission (Diver’s Alert Network, 2009). For the population of scuba divers in the United States, according to the 2008 DAN Diving Report, approximately 2505 injuries were reported in 2008. Although Decompression Illness (DCI) and Barotrauma were most frequently reported, at 26.4 and 25.6% respectively, the “working diagnosis” may not have been reflected the ultimate diagnosis and certainly not the ultimate cause. Predisposing factors such as preexisting illnesses affecting the lungs or circulatory efficiency must be considered. Other predisposing factors that increase risk might include obesity, age, and poor physical condition also need to be addressed.

Health Belief Model

Health education models and theories attempt to categorize and explain the large number of factors which can, and do, have an impact on human behavior. One of the first health models used to examine health problems is the Health Belief Model (HBM). The HBM (Rosenstock, 1974) is still one of the most widely accepted and used models in health behavior research (Campbell, 2001). It has also been identified as one of the most studied theories in health education (Bowden, Greenwood, & Lutz, 2005). The

Health Belief Model (HBM) has four main constructs: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers.

Perceived Susceptibility

Perceived susceptibility is a person's perception of the risk or belief about the likelihood of contracting a health condition. In approximately 25% of scuba related deaths, divers had a preexisting condition that was a contraindication to diving and should have excluded the individual from diving (Edmonds, Thomas, McKenzie & Pennefather, 2010). The first condition to be discussed in regards to an increased risk of dying while participating in diving activities is obesity. According to the National Education Association, Health Information Network (NEAHIN) adults who are obese are more likely to develop severe health problems including hypertension and coronary artery disease. Often, questions are asked whether diving while being overweight increases the risk for injury or death while diving. There are multiple reasons why increased fatty tissue is a significant factor to consider when a person is fit to dive. For the purposes of this study, increased risk of decompression illness (DCI), cardiovascular disease, and decreased physical fitness levels due to obesity will be discussed. Higher incidences of DCI rates have been recorded in divers who are 40 years of age and older. This is thought to be due to higher percent body fat and perhaps an increased prevalence of cardiovascular disease that is frequently observed in those who are obese (Edmonds et al., 2010).

There have been multiple studies indicating obesity as a contributing factor to DCI. United States Navy divers who developed DCI had notably higher percent body fat and weight when compared to those who were free of signs and symptoms of DCI (Dembert, Jekel, & Mooney, 1984). In another study, it was suggested that any diver whose weight is more than 20% in excess of currently accepted Body Mass Index (BMI) tables, should discontinue or be prevented from diving until enough weight has been lost (McMallum & Petrie, 1984). The findings in this study suggest that obesity may be a contributory factor to the occurrence of decompression sickness.

Being overweight or obese also increases a diver's risk for cardiovascular disease. Knowing one's BMI is essential to divers. Those with a high BMI are at higher risk of developing coronary artery disease and having a coronary event while diving than adults who do not have a high BMI. A BMI above 30 kg/m^2 is thought to be exceptionally hazardous for those who dive (Edmonds et al., 2010).

Additionally, those who are obese typically have decreased fitness levels that can lead to increased risk of decompression illness (DCI). They may also have a decreased ability to help in self and/or buddy rescue efforts due to exhaustion. The susceptibility to dying while participating in scuba diving activities due to being overweight or obese is high. The principal incentive to change a behavior is the level of perceived susceptibility of a specific condition. In the case of divers, the behavior change would be to lose weight prior to diving to decrease the risk of death. Those who are obese and do not think they are at higher risk of dying while diving are less likely to lose weight than those who perceive their risks to be high. They will also be less likely to choose to not dive until their BMI is within an acceptable range than those who recognize the risks involved. In addition to the level of susceptibility, the severity of the condition is equally important.

Perceived Severity

Perceived severity is an individual's belief about the seriousness of the condition as well as the consequences as the result of the condition. The likelihood that a person will change his or her health behaviors to evade a condition depends on how serious he or she considers the consequence to be (Green & Kreuter, 1999). Divers who do not see the seriousness of being overweight or obese are less likely to stop diving than those who do not see the seriousness of being overweight or obese. The severity of being overweight ranges from becoming fatigued to increased risk of death due to a coronary event. Unfortunately, in most cases these issues are not discussed in detail during scuba training. It is not until there is an incident to the diver or to someone close to the diver that the severity is realized. Until the severity is realized, it may be difficult to encourage individuals to change their behavior of losing weight.

Perceived Benefits

The perceived benefit is a person's opinion or belief about the effectiveness of a recommended action to reduce the risk or seriousness of the condition (Campbell, 2001). The positive results of a diver losing weight include decreasing his or her risk of DCI and coronary artery disease. In addition, losing weight would increase his or her ability to respond effectively during self and/or buddy rescue. Without the additional weight, the diver will not get as fatigued during high stress and high energy situations. The perceived benefit of losing weight will be difficult to instill until the susceptibility and severity are accepted. In addition, the perceived barriers could have the potential to interfere with the decision-making process.

Perceived Barriers

Perceived barriers are the material and psychological costs involved with changing a behavior. One of the main reasons people will not change their health behaviors is that they believe that doing so is going to be difficult (Campbell, 2001). It is not always the physical difficulty that is the biggest barrier; social problems loom larger. Divers typically socialize with other divers. If one's social group is participating in an activity such as diving, it would be difficult for most overweight divers to give up this hobby until their BMI is within an acceptable range. Besides the social pressure, there would be costs involved. Diving equipment is expensive. Those who participate in the sport have spent a considerable about of money and time in training and equipment. To overcome these barriers, the diver must be convinced of the increase risks or susceptibility of the condition, its severity, and the benefits of reducing ones risks of dying while diving.

Physical Requirements

Due to the potential physical demands required while diving, divers must be reasonably physically fit (Recreational SCUBA Training Council, 2009). Although divers are practically weightless while underwater, they must be able to exert enough energy to don their equipment, enter a dive site, swim continuously while diving, and then exit the dive site and remove their equipment. An average set of scuba equipment including an 80 cubic foot cylinder, one regulator system, and one buoyancy compensator, weighs approximately 55 to 60 pounds on land. Once in the water, although the equipment almost becomes weightless due to the effects of buoyancy, divers may encounter currents and other conditions requiring increased exertion. Following the dive, workloads will be increased while a diver exits the water and carries the equipment.

Because of the physical demands prior to, during, and after diving, divers must have good cardiovascular fitness. It has been recommended that divers have a minimum cardiovascular fitness level of 13 METS (metabolic equivalent) or 45.5 mls/kg/min to meet the requirements of diving (Pollock, 2007). According to the State Indicator Report on Physical Activity adults should participate in 150 minutes of moderate intensity physical activity per week or 75 minutes of vigorous intensity physical activity per week or a combination of the two (Centers for Disease Control and Prevention, 2010). Although there have been multiple studies on adult physical activity, there is a difference in self-reported numbers and those measured by accelerometer. Self-reported percentages are as high as 62%, yet when using accelerometers, fewer than 10% of U.S. adults met the Physical Activity Guidelines for Adults (Tucker, Welk, & Beyler, 2010). Thus, physical activity estimates vary substantially.

In addition to a baseline of general cardiovascular fitness, potential divers must complete a medical questionnaire prior to participating in scuba diving course. The medical form includes questions which inquire about specific cardiovascular risks as well as other conditions which may be contraindications to diving (Recreational SCUBA Training Council, 2009).

Participants in scuba courses are screened for conditions such as hypertension, coronary artery disease, obesity, and history of heart attack. Those who have a positive response to any of the contraindications are required to consult their physician prior to participation and on a regular basis after completion of the scuba course. Contraindications to diving are typically divided into absolute or relative categories. Divers with absolute contraindications are considered to be permanently at increased risk for injuries or death (National Association of Underwater Instructors, 2007). Those who have relative contraindications have a condition that may temporarily prevent them from diving until the condition is resolved with time or proper medical care. Relative contraindications with cardiovascular risks include, but are not limited to, a the history of myocardial infarction and/or hypertension. Obesity is listed as a relative contraindication under the metabolic and endocrinologic category.

Contraindications to Diving

A myocardial infarction, also called a heart attack, occurs when a section of the heart muscle dies or becomes damaged when the blood flow that brings oxygen to the heart muscle is severely reduced or cut off completely (American Heart Association, 2011). In the United States, coronary heart disease (CHD), which can lead to heart attack, is the number one cause of death for both men and women (U.S. Department of Health and Human Services, 2012). More than one half million Americans die annually from CHD.

During increased physical exertion, the heart's need for oxygen is increased. Individuals with coronary artery disease typically have decreased delivery of blood to the tissues in the body. Decreased blood flow results in less oxygen delivery to the muscular tissue of the heart. Depriving heart tissue of oxygen can lead to abnormal heart rhythms and/or myocardial infarction (Caruso, 1999). One of the classic symptoms of CHD is chest pain after increased physical activity. However, the majority of people do not have any symptoms before they have a heart attack. Of those who die, almost half do so suddenly, before they can get to a hospital (Ornato & Hand, 2011). According to Diver's Alert Network (DAN), cardiac-related death in diving is difficult to document. When one has an acute cardiac event while diving, the disruption of a normal heart rhythm may cause sudden unconsciousness and lead to drowning leaving no traces pointing to heart function. As mentioned previously, a heart attack can be triggered by increased physical activity possibly disabling a diver, resulting in drowning before there are significant changes to the heart's tissues (Diver's Alert Network, 2008).

Hypertension

One of the increased risks for developing heart disease is having high blood pressure. Hypertension, commonly referred to as high blood pressure, is a condition in which the arterial blood pressure is elevated above the normal range over a long period of time. "Normal blood pressure is when your blood pressure is lower than 120/80 mmHg most of the time." (Kshirsagar, Carpenter, Bang, Wyatt, & Colindres, p. 134, 2006). About 1 out of every 3 adults in the United States has high blood pressure. High blood pressure is one of the most common medical conditions seen among divers as well as in the general population (Caruso, 1999). In the United States, heart disease and stroke are the first and third leading causes of death (Centers for Disease Control and Prevention, 2009). Having excess weight and/or not being physically fit can lead to high blood pressure, increasing the risk for heart disease and stroke (American Heart Association, 2011). Obesity is therefore listed as a relative contraindication to diving.

Body Mass Index

A measurement of a person's Body Mass Index (BMI) correlates to the percent of body fat for most people. BMI is defined as weight in kilograms divided by height in meters squared (kg/m^2). This measurement can help determine overweight and obesity ranges. An adult who has a BMI between 25 and 29.9 is considered overweight and an adult who has a BMI of 30 or higher is considered obese (CDC, 2011). About one-third of U.S. adults (33.8%) are obese (Flegal, Carroll, Odgen, & Curtin, 2010). "No state has met the nation's Healthy People 2010 goal to lower obesity prevalence to 15%. The number of states with an obesity prevalence of 30% or more has increased to 12 states in 2010" (MMWR, 2010). Adults who are obese have an increased risk for many severe health conditions including coronary heart disease, hypertension, and stroke which can lead to premature death (Lloyd-Jones et al, 2010). In the past, the relationship between obesity and coronary heart disease has been viewed as indirect (Lew & Garfinkel, 1979). However, long-term longitudinal studies show that obesity alone predicts coronary atherosclerosis in both men and women with relatively small increases in BMI (Manson, Stampfer, Willet, Rosner, Monson, Speizer & Hennekens, 1990).

Summary

Scuba diving is a sport that can be enjoyed by a wide variety of individuals. Due to multiple contraindications, particularly those involving cardiovascular conditions, those participating in the sport may be increasing their risk of dying while participating in this recreational activity. By using data collected by Diver's Alert Network (DAN) along with results from the scuba survey, this study was designed to evaluate the extent to which divers are putting themselves at risk. Additionally, perceived risks and potential changes in health and dive related behaviors, were examined.

CHAPTER III

METHODS

In this case control study, there are three research questions and hypotheses. The research questions are:

Research Questions

1. When controlling for age and gender what effects do cardiovascular health conditions and obesity have on the likelihood of dying while participating in scuba diving activities?

2. When controlling for age and gender, what effects do cardiovascular health risks and obesity have on the divers' perception of their likelihood of dying while participating in scuba activities?

3. When controlling for age and gender, to what extent will divers alter their diving behaviors when they learn from their doctors that preexisting cardiovascular conditions and obesity may put them at risk of dying while engaging in Scuba activities?

Hypotheses

1. The more cardiovascular conditions that divers have, and the higher their BMI is, the more likely it is that they will die while participating in scuba diving activities. We will control for age and gender.

2. Divers with pre-existing cardiovascular health conditions perceive their chances of dying while participating in scuba diving activities to be higher than those without preexisting cardiovascular heart conditions.

3. Divers who are told by a physician to stop participating in scuba diving activities are more likely to stop diving than divers whose physician does not tell them to stop participating in scuba diving activities.

Power Analysis

A power analysis was run to determine the minimum sample size of cases and controls needed to achieve statistically meaningful results. The alpha level was set at 0.05 in order to control for Type I error. The model includes seven independent variables, two control variables and one dependent variable. GPower software was used in order to determine sample size. It revealed that a sample size of 116 controls and 58 cases would result in at least 80% power. The actual sample size was 198 controls with 62 cases. The sample size of 198 should have been sufficient to yield significant results, even when accounting for potential incomplete data.

Participants

In this study, data were collected from living divers and archived data on divers whose deaths were associated with scuba diving. The living diver sample consisted of a convenience sampling of active scuba divers who are 18 years of age or older. One hundred and ninety-two divers responded to an invitation to complete an online survey on ScubaBoard, an online scuba diving forum with over 185,000 members worldwide. Data on sixty-eight deceased divers was retrieved from the Diver's Alert Network archives. Data collected through DAN includes age, gender, preexisting medical conditions, body mass index (BMI), and cause of death. DAN relies on sheriff, police, emergency medical personnel, Coast Guard, medical examiners, coroners and members of the public to submit incident data to their fatality surveillance system.

Design

The case-control design was used in this study for the first hypothsis. Case-control studies are often used in epidemiological studies to help identify the cause and effect relationships of the specific conditions of concern. In this study the cases were those who died while diving and the controls were living divers who have preexisting cardiac conditions. Autopsy reports were used to document preexisting cardiovascular conditions for those who died while participating in scuba diving activities. In a case control study, the past medical history or exposure to a risk from a particular group of individuals is compared to the individuals who have similar characteristics but have not fallen victim to the risk. It is important to note that not all cases had a preexisting cardiovascular condition. Additionally, all causes of death were analyzed for the cases. A comparison was made between those divers who did and did not die due to a cardiac event and those divers who did not die of a cardiac event. Additionally, a cross-sectional survey was used to test hypotheses two and three.

Materials

All living participants agreed to participate in this study via an online informed consent prior to filling out an online survey on SurveyMonkey (see Appendix A). Demographic questions included questions about age, gender, height, and weight. These questions and answers allowed for covariate analysis by age and gender. The height and weight information provided was used to compute Body Mass Index (BMI).

BMI was computed by taking weight in pounds times 703 divided by height in inches squared. Participants were then asked about their diving experience, including the number of dives they had been on in the past year and their level of certification. These questions were used to create categories based on number of dives and certification level. As previously stated, an active diver is a diver who has been on at least five dives in the past year.

Participants were asked to complete a self-reported, five item, single response physical activity assessment, referred to as PA5. “The single response items were compared to a detailed measure of physical activity and the response items were correlated significantly, $r = .57$ ($p < .001$) with cardiorespiratory fitness determined with a maximal exercise test on a treadmill” (Jackson, Morrow, Bowles, FitzGerald, & Blair, 2007). Each participant’s response was based on five descriptors with an ordinal score ranging from 1 to 5. Sample responses from PA5 follow: Response 1: I don’t exercise or walk regularly now and I don’t plan to start in the near future; Response 5: I’ve been doing moderate physical activity 5 or more days a week or vigorous activity at least 3 days a week, for 7 months or longer.

Moderate and Vigorous Activity

Vigorous physical activity is defined to include any activity that makes you work as hard as jogging and lasts at least 20 minutes at a time. Examples include running, fast cycling, swimming laps, playing singles tennis or racquetball. Typically, the heart rate is increased, the participant sweats, and respiration is increased. Moderate physical activity is defined to include activities that make the participant work as hard as walking briskly for 8 to 10 minutes, increasing up to 30 minutes per day. Examples of these activities could include gardening, slow cycling, playing doubles tennis or dancing (Jackson et al., 2007).

Finally, participants were asked three questions related to the Health Belief Model which was an attempt to measure the impact of health on diving behaviors. The questions in this section helped determine the extent to which divers perceived the risk of dying while participating in scuba diving activities when preexisting cardiovascular conditions exist and the extent to which they were willing to change their health and/or diving habits.

Reliability of Survey

Approval to test the reliability of the Scuba Survey Version I was granted by the Middle Tennessee State University Institutional Review Board (see Appendix B). A link to the survey was emailed to 35 divers and non-divers. Out of the 35 volunteers that were solicited, 23 completed the pretest survey. After a two week period, the 23 volunteers were contacted again via email and asked to complete the survey a second time to gather posttest results. The data was exported from the SurveyMonkey website into an Excel™ spreadsheet. Data were imported into SPSS Version 20 for analysis. Out of the 23 surveys, one survey had missing data and was excluded from the results.

The reliability of the survey was tested using Cronbach's Alpha to measure internal consistency of the survey questions within groups. Four groups were tested: number of cardiovascular conditions, activity level, chances of dying, and stop diving. The Cronbach’s Alpha for all variables equals .939. For the number of cardiovascular conditions Cronbach's Alpha equals .885. For the group of questions dealing with activity level, Cronbach's Alpha was .844. The questions concerning chances of dying had a somewhat lower Cronbach's Alpha at .602 and the final group of questions concerning diving habits the Cronbach's Alpha equals .888. These results are presented in Table 1.

Table 1

Reliability of SCUBA Survey Pretest/Posttest (n = 22)

	Pretest		Posttest	
Characteristics	*M*	*SD*	*M*	*SD*
Cardiovascular conditions	6.36	1.33	6.41	1.05
Activity level	3.45	1.18	3.55	1.14
Chance of dying	3.14	0.07	3.00	0.71
Stop diving on doctor's advice	2.09	0.08	1.95	1.72

Note: Cronbach's Alpha for Postest = .939

After the reliability study was completed, approval for this case-control study was granted through the Institutional Review Board at Middle Tennessee State University (see Appendix C).The living participants were informed of this study through posts on the ScubaBoard forum. The message posted is included in Appendix D.

For the deceased divers, archived data from Diver's Alert Network was entered into a data entry program and uploaded to SPSS for analysis. To assist in the data entry process, data entry screens were created to simulate the hard-copy data forms. The screens were developed using a Windows-based data entry program (EpiData version 3.2). Data from the living divers were converted from SurveyMonkey into EpiData using data entry screens that are similar to the questionnaire. To prepare the data for analysis alphanumeric fields were converted to numeric fields.

Using EpiData allows for the identification of data that are inconsistent with associated responses; inconsistent data were not used in this study. The program also disallowed entry of data that were not within the acceptable response range. Additionally, EpiData identified skip patterns within the survey and automatically recorded missing data for items that were skipped. This feature helped to minimize error due to missing data. Data entry logs were used to track the steps in the data collection process, data cleaning, or data entry process at any given time. After data entry, quality control programs were run to check for internal consistency of related variables. Once the data were relatively clean, they were exported to SPSS for analysis. (N.L. Weatherby, personal communication, March 3, 2013).

Data from the files for the deceased and living divers were combined in SPSS into one analysis file. The files for death status were coded as 0 for the live divers and 1 for those whose deaths were associated with diving. Data from the living divers regarding cardiovascular conditions were coded so that they were consistent with the preexisting conditions coded for the deceased divers.

Data Analysis

Logistic regression analysis were used to analyze the effect of cardiovascular health conditions on the dependent variable of whether or not participants died while scuba diving. The hypotheses are:

1. The more cardiovascular conditions that divers have, the more likely it is that they will die while participating in scuba diving activities. Age, gender, and Body Mass Index (BMI), were controlled for.

2. Divers with preexisting cardiovascular health conditions perceive their chances of dying while participating in scuba diving activities to be higher than those without preexisting cardiovascular heart conditions.

3. Divers who are told by a physician to stop participating in scuba diving activities are more likely to stop diving than divers whose physician does not tell them to stop participating in scuba diving activities.

The control variables included age, gender, and BMI. The effects of the interactions among the independent variables were also measured.

The association between cardiovascular conditions and mortality among divers was estimated using odds ratio (*OR*) with the p value set at the .05 level, derived from logistic regression models. The risk factors of interest included obesity, lack of physical activity, previous heart or blood vessel surgery, hypertension, heart disease, previous heart attack, and family history of heart disease. The logistic regression models were adjusted to account for potential confounding factors. Statistical analyses were conducted using SPSS Version 20.

The classification analysis goal was to produce a model in which 80% of the observed deaths or survival while participating in scuba diving activities are correctly predicted using the logistic regression model.

A crosstab analysis was conducted between Body Mass Index and the participant’s level of exercise.

Summary

This study was used to answer the following research questions:

1. When controlling for age, gender and BMI, what effect do cardiovascular health conditions have on the likelihood of dying while participating in scuba diving activities?

2. When controlling for age, gender and BMI, to what extent do divers with cardiovascular health risks perceive their likelihood of dying while participating in scuba diving activities?

3. When controlling for age, gender and BMI, to what extent will divers alter their diving behaviors when they know about preexisting cardiovascular conditions?

The analysis of this study will help determine the effects of cardiovascular disease on the odds of dying while diving. The analysis will also help determine the extent to which divers perceive the risks of diving when preexisting cardiovascular conditions exist and the extent to which they are willing to change their diving habits.

CHAPTER IV

RESULTS

Data for the live controls in this study were collected from 192 scuba divers using the Scuba Survey Version 3. All divers were members of ScubaBoard, an online scuba diving forum. Data collected included demographic and background information as well as information from the Scuba Survey Version 3. Data for 68 deceased cases were collected using archived data from the Diver's Alert Network Annual Report. The information collected on the cases included age, gender, Body Mass Index, preexisting medical conditions, and cause of death.

There are three research questions for this study:

1. When controlling for age, gender and BMI, what effect do cardiovascular health conditions have on the likelihood of dying while participating in scuba diving activities?
2. When controlling for age, gender and BMI, to what extent do divers with cardiovascular health risks perceive their likelihood of dying while participating in scuba diving activities?
3. When controlling for age, gender and BMI, to what extent will divers stop diving when they know about preexisting cardiovascular conditions?

The characteristics on all participants are presented in two tables. Table 2 includes the dependent variable, which represents death caused by heart attack while scuba diving. The cause of death was recorded as dying from cardiovascular conditions or dying from other causes. Other causes of death included, but were not limited to, air embolism, entrapment, equipment failure, and other health issues not associated with a cardiac event. There are six categorical variables in which data were collected for both the cases and the controls. The data for the categorical variables represent cardiovascular risks including previous heart or blood vessel surgery, previous or current high blood pressure, previous heart disease and previous heart attack. There are three continuous variables. The first continuous variable is age. Those who were included in the data collection indicated they were 18 years of age or older prior to filling out the survey. How many dives a diver had completed in the past year was asked of the controls to verify that the divers are active divers. Since the live divers reported their weight in pounds and height in inches, Body Mass Index (BMI) was computed by multiplying weight in pounds times 703 divided by height in inches squared. BMI was collected through autopsy reports on the cases, those who have died while diving. The results are presented in Table 2.

Table 2

Case-Control Study Characteristics, Predictors of Dying While Scuba Diving (n= 260)

Characteristic	Divers (Controls) *n* =198		Deceased (Cases) *n* =62	
	M	*SD*	*M*	*SD*
Age	45.05	12.86	46.79	10.12
Body Mass Index	27.58	4.72	30.11	6.02
Dives in last year	65.21	79.27	unknown	
	n	*%*	*n*	*%*
Death caused by heart attack	*not applicable*		*22*	*32.80*
Sex				
Men	155	80.73	56	83.58
Women	37	19.27	11	16.42
Ever had heart surgery	4	2.08	3	4.48
Ever had blood vessel surgery	9	4.69	2	2.99
Ever had high blood pressure	39	20.31	22	32.84
Takes blood pressure medicine	33	17.19	1	1.49
Ever had heart disease	6	3.13	33	49.25
Ever had a heart attack	2	1.04	2	7.46

Table 3 includes categorical variables that were only collected on the living divers. The variables include certification level, whether or not the diver was able to perform moderate exercise, the diver's current activity level, if there was a family history of heart disease, the diver's perception about the chance of dying while scuba diving when cardiovascular conditions were present, if the diver would change his or her diving behavior if a doctor considered them overweight, and if the diver would stop diving if they developed cardiovascular conditions in the future. Certification levels were divided into five categories. The basic diver is someone who has earned basic open water status. The advanced certification included those who have earned advanced open water status or other specialty certifications. Some of the specialty certifications include Nitrox, Rescue, and Master Diver. Divemaster was the next category, which represents those divers who have just entered into a leadership level. Category 4 included Scuba Instructors while Category 5 was other. Category 5 included those who had technical training such as cave, Trimix, rebreather, and wreck diving certifications.

The next categorical variable asked if a diver was able to perform moderate exercise by walking 1.6 km/one mile within 12 minutes. The variable about a diver's current activity level had five items the participants could choose from, ranging from they were not exercising and were not thinking about it to performing moderate physical activity five or more days a week or vigorous activity at least three days a week, for seven months or longer. Divers were asked if they were diagnosed with a cardiovascular health condition in the future, (heart disease, high blood pressure, previous heart attack, etc.) what they thought their chances of dying while scuba diving are with responses ranging from high chance to almost no chance.

Table 3

Living Divers Characteristics, Predictors of Dying While Scuba Diving (n = 198)

	Divers (Controls)	
Characteristic	*n*	*%*
Certification level		
Basic	30	15.79
Advanced	97	51.05
Divemaster	19	10.00
Instructor	21	10.94
Other	23	11.98
Able to perform moderate exercise	178	92.71
Activity level		
Does not exercise and not thinking about it	7	3.65
Does not exercise but thinking about it	27	14.06
Moderate exercise fewer than 5 days per week	89	46.35
6 months	24	12.50
7 months	45	23.44
Has family history of heart disease	77	40.10
Chance of dying		
High	5	2.60
Moderately high	19	9.90
Some	132	68.74
Almost No	27	14.06
Will stop diving until weight is within range	29	15.10
Will stop diving on doctor's advice		
Definitely	25	13.16
Probably	99	52.10
Probably not	54	28.42
Definitely not	12	6.32

For the variable about behavior change, the living divers were asked, “If you were told by a doctor that you were overweight, would you consider not diving until your weight was within an acceptable range?” The final variable in this case control study asks divers if they were told by a doctor that they had a cardiovascular health risk, would they stop diving. The results are presented in Table 3.

The first hypothesis, “When controlling for age, gender and BMI, what effect do cardiovascular health conditions have on the likelihood of dying while participating in scuba diving activities?” was analyzed using a logistic regression. There was considerable overlap between those who had high blood pressure and those who had high blood pressure controlled by medication. These variables were combined into a new variable with three categories. The categories for this new variable were those who had high blood pressure and controlled it with medication, those who had high blood pressure that was not controlled with medication with the third category for those who did not have high blood pressure. The variables for those who had had a previous heart surgery, blood vessel surgery, high blood pressure, heart attack and for those who died while diving were recoded into new variables with responses being mentioned if the previous response was yes or not mentioned if the previous response was no or was unknown.

After recoding the variables, another logistic regression analysis was run. At this point the variables for those who had mentioned having previous heart surgery and or previous blood vessel surgery were combined into a new variable. The new variable had two categories which included those who mentioned having previous heart or blood vessel surgery with the second category for those who did not mention having previous heart or blood vessel surgery. Logistic regression were run again to confirm the variables no longer had considerable overlap.

The reduced interaction model included six main effects and one interaction term. In this model, the Nagelkerke R-square indicated that the independent variables in the model explained 12.3% of the variation in the dependent variable. Although this model was significant ($p < .000$) the model only correctly classified 74.9% of the cases. When controlling for age, whether or not a diver had a previous heart attack, blood vessel surgery, heart surgery and high blood pressure, the higher a diver's BMI is, the less likely it is they will die while participating in scuba diving activities. The odds ratio is 0.92 with a 95% CI [0.87, 0.98]. This result is significant ($p = .008$). The interaction between age and high blood pressure was not significant in this model ($p = .54$). Results are presented in Tables 4.

The second step was the main effects model, presented in Table 5. Since the interaction between high blood pressure and age was almost significant ($p = .054$) high blood pressure and age were left in the main effects model. 10.2% of the variation in predicting death while scuba diving was explained by the other variables in this model. The only variable in this model that was significant was BMI ($p = .011$). The odds ratio is 0.93 with a 95% CI [0.88, 0.98]. Results are presented in Table 5.

Table 4

Summary of Logistic Regression Analysis Predicting Death While Diving (*n* = 259)

Variable	*b*	*SE*	Odds ratio	95% Confidence Interval Lower	Upper	Wald statistic	df	*p*
Step 1: Reduced Interaction Model								
Main Effects:								
Constant	3.97	1.07				13.86	1	0.000
BMI	-0.08	0.03	0.92	0.87	0.98	7.10	1	0.008
Age	-0.01	0.01	0.99	0.96	1.01	0.88	1	0.348
Had previous heart attack	-2.15	1.21	0.12	0.01	1.25	3.14	1	0.076
Had previous blood vessel surgery	1.71	1.27	5.53	0.46	66.02	1.83	1	0.176
Had previous heart surgery	-0.13	1.06	0.88	0.11	7.06	0.01	1	0.906
Had high blood pressure	-3.88	1.92	0.02	0.00	0.90	4.06	1	0.044
Interactions:								
Had high blood pressure * Age	0.07	0.04	1.08	1.00	1.16	3.72	1	0.054

Note: Model Chi Square = 22.36, *df* = 7 , (p < .05); -2 Log Likelihood = 271.36. Nagelkerke R^2 = .123

Table 5

Summary of Logistic Regression Analysis Predicting Death While Diving (*n* = 259)

Variable	*b*	*SE*	Odds ratio	95% Confidence Interval Lower	Upper	Wald statistic	df	*p*
Step 2: Main Effects Model								
Main Effects:								
Constant	3.35	1.00				11.21	1	0.001
BMI	-0.07	0.03	0.93	0.88	0.98	6.44	1	0.011
Age	0.00	0.01	1.00	0.97	1.02	0.03	1	0.857
Had previous heart attack	-2.43	1.23	0.09	0.01	0.97	3.94	1	0.047
Had previous blood vessel surgery	1.68	1.23	5.39	0.48	60.40	1.87	1	0.172
Had previous heart surgery	-0.02	1.03	0.98	0.13	7.38	0.00	1	0.982
Had high blood pressure	-0.19	0.37	0.83	0.40	1.71	0.26	1	0.607

Note: Model Chi Square = 18.46 , *df* = 6 , ($p < .05$); -2 Log Likelihood = 275.26 Nagelkerke R^2 = .102

Table 6

Summary of Logistic Regression Analysis Predicting Death While Diving (*n* = 259)

Variable	*b*	*SE*	Odds ratio	95% Confidence Interval Lower	Upper	Wald statistic	df	*p*
Step 3: Final Main Effects Model								
Main Effects:								
Constant	3.61	0.81				19.65	1	0.000
BMI	-0.09	0.03	0.91	0.87	0.96	10.64	1	0.001

Note: Model Chi Square = 11.09 , *df* = 1, (p < .05); -2 Log Likelihood = 282.62 Nagelkerke R^2 = .062

The last step was the reduced Parsimonious Model. Here the effects of age and BMI on dying while scuba diving were analyzed. In this step, 6.2% of the variation in dying while scuba diving is explained by the other independent variables. This result is significant (*p* = .001). These data indicated that the higher a diver's BMI is, the less likely it is that they will die while participating in scuba diving activities. This result is significant (*OR* = .91, Wald = 10.64, *df* = 1, *p* = .001). There is no association between BMI and physical activity level. The percent of divers who were overweight or obese was similar across all levels of physical activity. Level of physical activity has no effect on the BMI of divers. The result that BMI was negatively related to the odds of dying while participating in diving activities is probably not due to their level of physical activity. Results are presented in Table 6.

Hypotheses Two and Three

Logistic regressions were run on the second and third hypotheses. The hypotheses are: (2) When controlling for age, gender and BMI, to what extent do divers with cardiovascular health risks perceive their likelihood of dying while participating in scuba diving activities, and (3) when controlling for age, gender and BMI, to what extent will divers who have pre-existing cardiovascular conditions stop diving? While running the logistic regression for the second hypothesis, there were unexpected singularities in the Hessian matrix. This indicated that some categories should be merged. The variables of those who had mentioned or not mentioned having previous heart surgery and those who had mentioned or not mentioned having previous blood vessel surgery, were combined into a new variable. The new variables are explained in the next section.

Each variable was then tested individually to identify which variables were causing the singularity warning.

Recoding Variables

First, the variable asking the divers about their perception of their chance of dying while participating in scuba diving activities was recoded into two categories. The first category included those who felt they had a high or moderately high chance of dying while the second category included those who believed they had some to almost no chance of dying. Next, the variable asking about previous heart or blood vessel surgery was combined with the data about an individual's family history. This new variable had three categories which included those who had received heart and/or blood vessel surgery and also had a family history of cardiovascular conditions. The second category included those who had a family history but had not had heart and/or blood vessel surgery. Those who did not have a family history and had not had heart and/or blood vessel surgery were grouped into the third category. The last variable to be recoded was the variable which indicated the history of high blood pressure. This variable was also recoded into three categories. The divers who did not have high blood pressure were in the first category. The divers who had high blood pressure and controlled it with medication were grouped into the second category and the divers who had high blood pressure that was not controlled with medication were grouped into the third category. Other variables included in this model were sex, the diver's certification level, the number of dives they had participated on in the past year, and their current activity level. The insignificant variable defining if a diver could sustain moderate activity was used only to define the subpopulation and was not used to construct the model. Logistic regressions were run after combining the necessary variables and there were no singularities.

Hypothesis Two

The hypothesis tested in this model was testing the extent to which divers with preexisting cardiovascular health conditions perceived their chance of dying while participating in scuba diving activities. The reference category for this model was the combined variable of those who perceived their chance of dying while participating in scuba diving activities to be some chance to almost no chance. In this model, the Nagelkerke R-square indicated that 11.3% of the variation in the dependent variable was explained by the other independent variables. This model was not significant (p = .796).

Demographic Variables

The demographic variables in this model included sex, age, the number of dives per year, the diver's certification level and Body Mass Index (BMI). The perceived chance of dying while participating in scuba diving activities for males was not significant (*OR* = 1.00, Wald = .00, *df* = 1, p = .997). The age of a diver did not have a significant effect on the chance of dying while diving (*OR* = .99, Wald = .40, *df* = 1, p = .525) nor did the number of dives a diver had participated in during the past year (*OR* = .99, Wald = .40, *df* = 1, p = .525). The diver's certification level did not have a significant effect on their perceived chance of dying. This variable had four categories including the certification level of basic open water diver (*OR* = .30, Wald = 1.28, *df* = 1, p = .258), an advanced open water diver (*OR* = .87, Wald = .03, *df* = 1, *p* = .856), a Dive Master (*OR* = 1.71, Wald = .31, *df* = 1, *p* = .579) and Instructor (*OR* = 4.06, Wald = 2.33, *df* = 1, *p* = .127). The last demographic variable tested in this hypothesis, Body Mass Index (BMI), did not have a significant effect on the dependent variable (*OR* = .98, Wald = .11, *df* = 1, *p* = .742).

Cardiovascular Health Risk Variables

After recoding, there were two variables related to cardiovascular health risks. First, the extent to which divers that did not have high blood pressure perceived their chance of dying while scuba diving was examined. The results were not significant (*OR* = 1.05, Wald = .00, *df* = 1, *p* = .967). For the divers who had high blood pressure and controlled it with medication the result was not significant (*OR* = .50, Wald = .25, *df* = 1, *p* = .615). The other variable tested was the combination of those who had a family history of cardiovascular conditions and had heart and/or blood vessel surgery. For those who had surgery regardless of their family history, the results were not significant (*OR* = .30, Wald = .39, *df* = 1, *p* = .336) nor were they significant for those who had a family history but no surgery (*OR* = .66, Wald = .64, *df* = 1, *p* = .425). In summary these results were not significant.

Activity Level

The last variable tested in this model examined the extent to which a diver's perception of his or her chance of dying was related to his or her activity level. This variable had four categories. Regardless of a diver's activity level, from not exercising at all to exercising at a moderate rate for five days or more for seven months or more, the results were not significant.

Table 7

Logistic Regression Analysis of Perceived Chance of Dying [a] (*n* = 174)

Variable	*b*	*SE*	Odds ratio	95% Confidence Interval Lower	Upper	Wald statistic	df	*p*
Final Main Effects Model:								
Constant	-0.71	2.40				0.09	1	0.768
High or moderately high chance of dying compared to some or almost no chance of dying								
Men	0.00	0.59	1.00	0.31	3.18	0.00	1	0.997
Age	-0.01	0.02	0.99	0.95	1.03	0.40	1	0.525
Body Mass Index	-0.02	0.05	0.98	0.88	1.09	0.11	1	0.742
Number of dives per year	0.00	0.00	1.00	1.00	1.00	1.08	1	0.298
Activity Level								
Does not exercise and does not plan to start	1.75	1.11	5.75	0.65	50.62	2.49	1	0.115
Does not exercise but is thinking about starting	1.20	0.84	3.31	0.63	17.30	2.02	1	0.155
Moderate exercise fewer than five days per week	-0.04	0.64	0.96	0.28	3.34	0.00	1	0.949
Moderate exercise five days or more for less than six months	0.86	0.81	2.37	0.49	11.54	1.14	1	0.285
Moderate exercise five days or more for more than seven months	(reference)							

Note: Model Chi Square = 11.21 , *df* = 16, (*p* = .796); -2 Log Likelihood = 128.41 Nagelkerke R^2 =

[a] The reference category : Some or almost no chance of dying

Table 7 (Continued)

Logistic Regression Analysis of Perceived Chance of Dying [a] (n = 174)

Variable	b	SE	Odds ratio	95% Confidence Interval Lower	Upper	Wald statistic	df	p
Final Main Effects Model:								
High blood pressure and medication								
No high blood pressure	0.05	1.27	1.05	0.09	12.73	0.00	1	0.967
High blood pressure controlled with medication	-0.69	1.37	0.50	0.03	7.35	0.25	1	0.615
Uncontrolled high blood pressure	(reference)							
Family history and heart or blood vessel surgery								
Surgery with or without family history	-1.16	1.21	0.31	0.03	3.34	0.93	1	0.336
Family history without surgery	-0.42	0.53	0.66	0.23	1.85	0.64	1	0.425
Neither	(reference)							
Certification Level								
Basic open water	-1.20	1.06	0.30	0.04	2.40	1.28	1	0.258
Advanced open water	-0.14	0.77	0.87	0.19	3.93	0.03	1	0.856
Divemaster	0.54	0.97	1.71	0.25	11.55	0.31	1	0.579
Instructor	1.40	0.92	4.06	0.67	24.52	2.33	1	0.127
Other	(reference)							

Note: Model Chi Square = 11.21 , df = 16, (p = .796); -2 Log Likelihood = 128.41 Nagelkerke R^2 = .113

[a] The reference category is: Some or almost no chance of dying

Hypothesis Three Classification Tree for Stop Diving

With this model, there were no significant main effects or interaction terms. In an effort to solve the singularities warning, Classification and Regression Tree (CART) analysis was used. The CART method begins with the dependent variable of a diver determining to what extent they would stop diving as the parent mode. The tree then splits into child nodes based on values of the independent variable that determined the split (Weatherby, Kang, Shapshak, McCoy and Chiappelli, 2006). Using descriptive statistics, frequencies were first run on the dependent variable asking divers if they would stop diving if they were diagnosed with a cardiovascular health risk in the future. The answers ranged from divers indicating they would definitely stop diving (13.2%) to probably stop diving (52.1%) to definitely would not stop diving (6.35%).

First Child Node

The first branch of the classification tree showed that the independent variable showing how many dives a person had been on in the past year had the most variation on the dependent variable. For this first split, there were three groups referencing how many dives a diver had been on in the past year. The groups were established with those who had been on less than 25 dives in the past year, those who had been on between 25 and 90 dives in the past year and those who had been diving more than 90 times in the past year. For the category of those who had been diving less than 25 times in the past year, fifteen (25%) said they would definitely stop diving. Thirty-seven (61.7%) said they would probably stop diving and only eight (13.3%) said they would probably not stop diving. For this category of the less experienced divers, none said they would definitely not stop diving.

For the second category, those divers who had between 25 and 90 dives in the past year, eight (8.6%) said they would definitely stop diving. Forty-eight (51.65%) said they would probably stop diving while thirty-three (35.5%) said they would probably not stop diving. The last response which indicated the diver would definitely not stop diving increased from zero responses for those who had less than 25 dives in the past year to four (4.3%) saying they would definitely not stop diving if told to by their doctor. There seems to be a steady change in responses depending on the number of dives a diver has been on in the past year. For those who had been on more than 90 dives in the past year, only two (5.4%) said they would definitely stop diving while eight (21.6%) said they would definitely not stop diving.

Second and Terminal Node

The classification tree split for a second time among divers who had been on more than 90 dives in the past year. There were a total of thirty-seven divers in this category which is 19.5% of the sample. For this group of divers, Body Mass Index (BMI) was an important factor. BMI was split into two categories of those who had a BMI of 29.156 and those who had a BMI higher than 29.156. This split produced some interesting results. Two (6.9%) of the divers who had a Body Mass Index (BMI) of 29.156 or less indicated they would definitely stop diving. Fourteen (48.3%) of the divers in this category indicated they would probably stop diving while ten (34.5%) said they would definitely not stop diving if they were diagnosed with cardiovascular health conditions in the future.

Interestingly, out of the divers who were in the high BMI category, zero said they would definitely or probably stop diving. Three (37.5%) said they would probably not stop diving and five (62.5%) said they would definitely not stop diving.

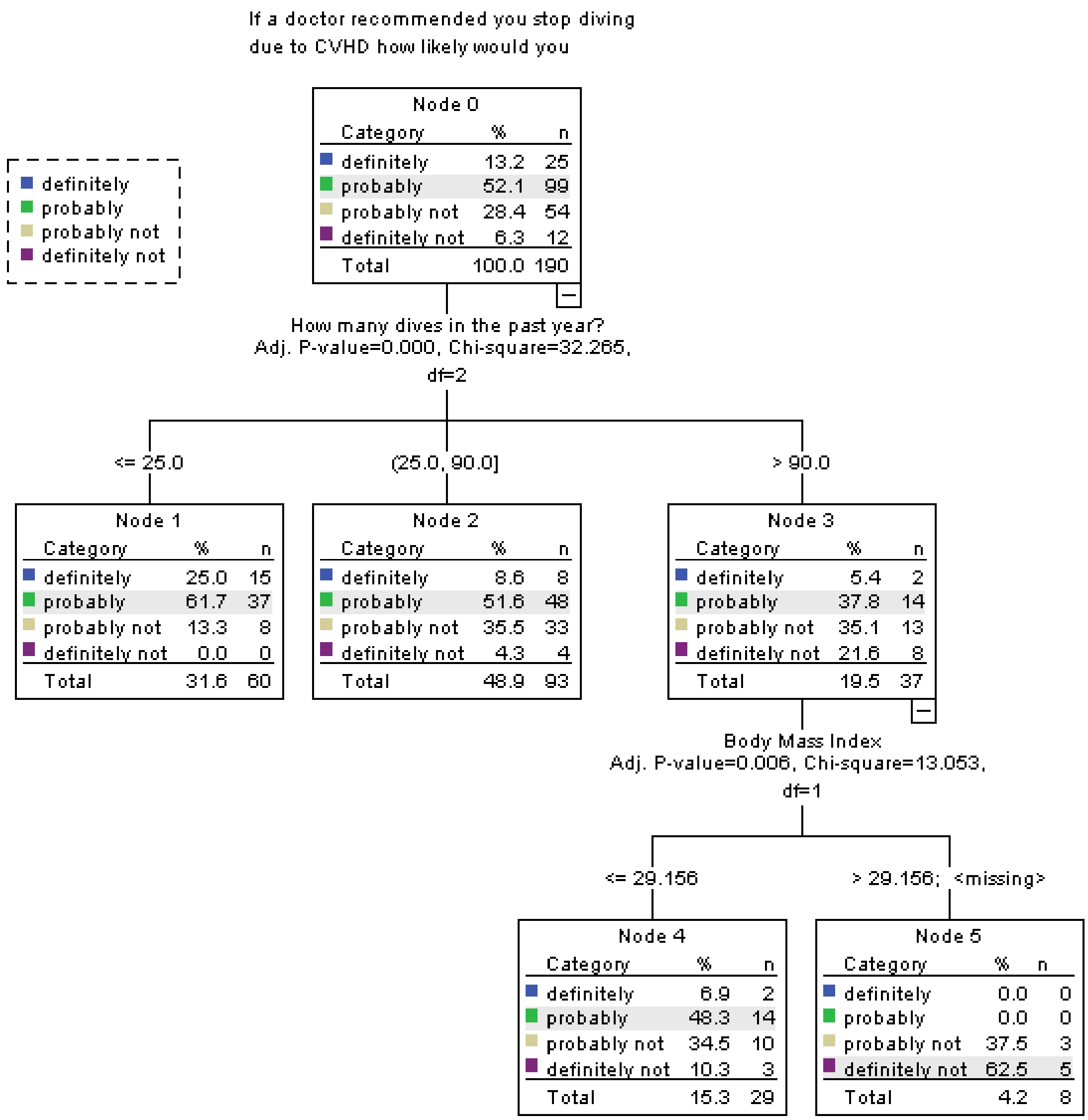

Figure 1

Classification Tree Analysis

Logistic Regression

Logistic regression analyses were run based on the important variables in the Classification and Regression Tree (CART) analysis. The data for the final main effects model are presented in Table 8.

The final main effects model was used for this analysis and included divers who would definitely stop diving, those who will probably stop diving and those who will probably not stop diving. The reference category for this model is the divers who indicated they would definitely stop diving. In this model, the Nagelkerke R-square indicated that 11.7% of the variation in the dependent variable was explained by the independent variables. Although this model was significant ($p < .05$) the model only correctly classified 54.7% of the cases.

The two important variables in this model are the number of dives a diver participates in during a year and his or her Body Mass Index (BMI). Therefore the extent to which the number of dives a diver participates in during a year and BMI have on a diver's decision to stop diving if diagnosed with cardiovascular health conditions in the future were examined next. BMI was not significant for any of the three main effects. However, the number of dives a diver participates in within a year does have a significant effect in all three response categories. For the divers who indicated they will definitely stop diving, the number of dives the diver participates in is significant (*OR* = .98, Wald = 8.06, *df* = 1, $p = .005$). For the divers who indicated they will probably stop diving, the number of dives the diver participates in is significant (*OR* = .99, Wald = 5.89, *df* = 1, $p = .015$). When controlling for age, gender and BMI, those who dive more than ninety dives per year, are less likely to stop diving when their physician tells them to stop diving due to cardiovascular health conditions, than are the divers who dive less than ninety dives per year. The results are presented in table

Table 8

Logistic Regression Analysis Based on Classification Tree for Stopping Diving [a] (*n* = 192)

Variable	*b*	*SE*	Odds ratio	95% Confidence Interval Lower	95% Confidence Interval Upper	Wald statistic	df	*p*
Final Main Effects Model:								
Main Effects: Will definitely stop diving								
Constant	4.80	2.34				4.20	1	0.041
Number of dives per year	-0.02	0.01	0.98	0.97	0.99	8.06	1	0.005
Body Mass Index	-0.10	0.08	0.91	0.78	1.06	1.53	1	0.217
Main Effects: Will probably stop diving								
Constant	6.20	2.07				8.98	1	0.003
Number of dives per year	-0.01	0.00	0.99	0.98	0.99	13.11	1	0.000
Body Mass Index	-0.11	0.07	0.90	0.79	1.03	2.46	1	0.117
Main Effects: Will probably not stop diving								
Constant	3.90	2.09				3.51	1	0.061
Number of divers per year	-0.01	0.00	0.99	0.99	1.00	5.89	1	0.015
Body Mass Index	-0.06	0.07	0.95	0.83	1.08	0.67	1	0.414

Note: Model Chi Square = 20.68 , *df* = 6, (p < .05); -2 Log Likelihood = 398.97 Nagelkerke R^2 = .117

[a] The reference category is: Will Definitely Not Stop Diving

CHAPTER V

DISCUSSION

Purposes of Study

The main purposes of this case-control study were to examine the relationship between cardiovascular health conditions and mortality among scuba divers and the physical fitness levels and medical status of active divers. The secondary purposes of this study were to determine the extent to which those divers who do have preexisting heart conditions perceive their risk of dying while diving, and to determine the extent to which they are willing to change their diving behaviors.

In 1982, Diver's Alert Network (DAN) started collecting data related to diving accidents and fatalities focusing on decompression sickness. As the years progressed, DAN's research continued and expanded to fatalities related to technical diving, diving with rebreathers, breath-hold diving, and deaths due to diabetes. In 2005, DAN conducted research on the causes, incidence and risk factors of diving fatalities and presented the findings at the 2010 Recreational Diving Fatalities workshop. As the findings were presented, it was discovered there was a need to add information in dive training courses about the common causes of injuries and fatalities while participating in scuba diving activities. The health requirements and contraindications to diving were examined and the cardiac causes of death were addressed (Denoble, 2009).

DAN currently has an ongoing study using the Health and Diving Practices Survey. Results to date indicate that in order to determine the extent to which diving with known cardiovascular health risks may affect the mortality of divers, more research is needed (DAN, 2013).

Effects of Cardiovascular Conditions

The results of this study indicate that the only significant variable that predicted the likelihood of a diver dying while diving is a diver's Body Mass Index (BMI). The results indicate that those with a higher BMI are less likely to die while participating in scuba diving activities than those with a normal BMI. The other preexisting cardiovascular risks evaluated, such as having a previous heart attack, previous heart or blood vessel surgery, having high blood pressure, and having a family history of cardiovascular disease, did not have a significant effect on a diver's mortality.

The finding that those who had a higher BMI had a lower risk of dying while diving is interesting. There are multiple possibilities to explain this. In a recent study, it was suggested that the mortality risk due to cardiovascular conditions was five to six percent lower for those who were in the overweight and moderately obese categories than for people of normal BMI (Flegal et al., 2013). Although convenient, BMI is not a good measure of muscle mass or percent body fat. Higher body fat and lack of exercise can increase the risk of heart disease. Additionally, BMI does not consider the overall fitness of an individual. Another possibility as to why those with a higher BMI were less likely to die while participating in scuba diving activities is the fact that more than seventy percent of the controls reported that they participated in some sort of moderate physical activity. It is possible that divers, although having a higher BMI, on average are actually in good physical condition. Because they participate in regular moderate physical activity, it is reasonable to believe that they have a higher percentage of lean body tissue than adipose tissue.

Strengths

For the first hypothesis, this study presents several strengths. The participants were recruited through Scubaboard, an online forum representing a wide range of divers. Although the participants were not asked where they reside, typically on this forum those who post comments are from all across the United States. Geographic area has been observed when divers post on the forum. Their username, city and state are listed on their post and are indicated in diver's personal profile. It is assumed that those who participated in this study were from various geographical areas, giving this study a good representation of divers. As divers read the post, many replied to the post indicating they were going to complete or had already completed the survey. In observing the reply post, divers were from various geographical areas within the United Sates. In addition, when the two data sets were combined, we were able to compare cardiovascular risk factors between the live divers and those who had died while participating in scuba diving activities, on mortality among scuba divers. Another strength in this study is that the demographic characteristics of the live divers, such as age and gender, closely matched the age and gender of those who died while diving as indicated in Table 2 which included the participant's characteristics. Furthermore, the findings of this part of the study support the need for increased awareness of the importance of staying in good physical shape and exercising moderately among those divers who do not exercise on a regular basis.

Limitations

Although there were several strengths, there were also several possible limitations. The variables included in the case-control study were limited to those that were listed on the autopsy reports from the archived data. In order to merge the files for the analysis, the cardiovascular conditions listed in the autopsy reports had to be the same conditions reported by the live divers. For example, Body Mass Index (BMI) was used as a measure for the deceased divers so it was also used for the live divers even though previous studies indicated it was not the best measure of excessive adipose tissue. It can also be assumed that since the autopsies were performed by different medical examiners, the preexisting cardiovascular conditions could have been described differently to a certain extent, leading to misclassification. Although there are standards that need to be followed during an autopsy, there is room for difference in medical opinions (J.M. Nunley, personal communication, March 12, 2013). Another limitation to this study is that the results from the live divers were all self-reported. Although it is assumed that the divers would answer the survey questions to the best of their ability and would provide honest answers, there is not a mechanism to measure the number of questions that were answered honestly and accurately.

Another limitation that may have impacted the results of this study was the low number of participants overall. Further research should be conducted with a larger sample to test the effects of cardiovascular conditions since previous studies have shown that preexisting conditions are important factors among in diver mortality.

Summary of Effects of Cardiovascular Conditions

In summary, results indicate that when controlling for the other variables in the model, divers with higher BMI's are less likely to die when participating in scuba diving activities than those with lower BMI. This study demonstrates that maintaining a healthy lifestyle and fitness level may be one of the more important factors in reducing mortality among divers. It is possible that those who responded to the survey had higher BMI's due to increased muscle mass and not increased adipose tissue.

Research Recommendations on Cardiovascular Conditions

Based on these results, further research using a more accurate measure of obesity other than BMI is indicated. It is also recommended that training agencies consider adding information concerning the importance of regular exercise and general well-being to diver training materials.

Perceived Chance of Dying

The second hypothesis in this study was examined the extent to which divers with preexisting cardiovascular health conditions perceived that they may have higher chance of dying while participating in scuba diving activities than those without cardiovascular health conditions. It is important to examine each of the variables or group of variables tested in this hypothesis. The demographic variables included sex, age, the number of dives per year, the diver's certification level and Body Mass Index (BMI). This study found that regardless of a diver's sex, age, the numbers of dives per year, certification level and/or BMI, divers are not aware of or are ignoring the risks of diving with known cardiovascular health conditions. this is especially critical in light of one of the most recent surveys conducted by the Diver's Alert Network (DAN), which showed that cardiovascular diseases are the leading cause of death in the United States and one of the most common causes of fatal diving accidents (DAN, 2013).

This study also showed that divers did not perceive their chance of dying while diving to be important when preexisting cardiovascular conditions exist. There was no difference in perception between those who had high blood pressure, those who had high blood pressure controlled with medication and those who did not have high blood pressure. There was also no significant difference in perceived chance of dying among those who had a family history of cardiovascular disease or previous heart or blood vessel surgery. There was no significant relationship between a diver's activity level and their perceived chance of dying.

Although the results of this study showed that demographics, preexisting cardiovascular conditions, and activity levels did not accurately predict the mortality of divers, there are other studies that contradict this result. According to research conducted through Diver's Alert Network (DAN). DAN is one of the leading authorities on diving medicine but there are divers who for various reasons are not members of DAN. The results of the DAN studies dealing with the risks involved when diving with cardiovascular health conditions may be viewed mostly by the divers who are DAN members, and those who are non-members may not be receiving this important information. Perhaps dive instructors and scuba diving agencies should have a duty or responsibility to present the latest findings to the individuals who earned a certification in an effort to reach a larger population of divers.

Strengths of Perceived Chance of Dying

This study shows that divers do not seem to be concerned or aware of their chance of mortality while diving with cardiovascular health conditions. This finding supports a strong argument to add topics related to the cardiovascular risks to scuba diving training courses. Educating divers about the risks involved in diving with preexisting conditions may contribute to divers changing their perceptions about mortality and may in turn reduce the number of fatalities related to the cardiovascular health conditions.

Limitations of Perceived Chance of Dying

Although important results about cardiovascular disease and diving were evaluated in this study, the results may be skewed. The variables associated with cardiovascular health conditions and those associated with a diver’s activity level showed no significant effect on the diver’s perceived chance of dying. Therefore, it is assumed the diver’s do not realize the risks involved in diving when cardiovascular conditions exist. These results are supported by the constructs in the Health Belief Model in the sense that diver’s may not know or understand the perceived severity or susceptibility of diving with known cardiovascular health conditions.

Research Recommendations on Perceived Chance of Dying

It is recommended that a pretest posttest intervention study be conducted to determine the extent to which a diver’s perception of dying while diving changes after important results concerning diving with preexisting cardiovascular conditions have been presented. It is also recommended that further research using the Health Belief Model be conducted to determine the level of perceived severity and susceptibility.

Summary of Perceived Chance of Dying

This study showed that divers with preexisting cardiovascular health conditions do not perceive their chance of dying while participating in scuba diving activities to be higher than those without preexisting cardiovascular heart conditions. These results indicate that the divers who participated in this study are unaware or unconcerned of the severity of diving with cardiovascular conditions.

Stop Participating in Diving

The third and final hypothesis in this study is: Divers who are told by a physician to stop participating in scuba diving activities are more likely to stop diving than divers whose physician did not tell them to stop participating in scuba diving activities.
To the researcher's knowledge, this question has not been previously investigated and there is no known data to support or negate the findings. When the first Logistic Regression was run, there were no significant main effects or interaction terms and SPSS could not accurately estimate the effects because there was not enough variation in the data. In order to solve this issue, a Classification Tree analysis was conducted.

Interesting results were discovered during this process. The most important variable in determining the extent to which a diver would consider stop diving based on medical advice was found to be the number of dives a diver had participated in during the past year. The divers who had the fewest dives were more likely to stop diving than those with more dives. The majority of the divers who had fewer dives indicated they would definitely or probably stop diving if a physician told them to stop. The divers who had the most experience, with more than 90 dives per year, indicated for the most part that they would probably not or would definitely not stop diving. The findings here can also be directly related with the Health Belief Model particularly with the construct dealing with perceived barriers. Divers who dive often are apparently not going to give up the activity easily. It is reasonable to assume that divers who said they would not stop diving if told to by a physician have a considerable amount of time and money invested in diving. In addition to the money and time invested, divers have a social network of friends that are most likely divers. For a diver to stop diving because a physician told them to would be asking them to give up a recreational activity they are invested in and to give up a network of friends. To most people, regardless of the activity giving up these important factors would be difficult.

Another factor to consider is that this study also found that divers did not perceive their chance of diving to be of any significance if they had a preexisting cardiovascular condition. In combination with the monetary and social investment to dive it is reasonable to conclude that divers would not stop diving regardless of the possible negative outcome.

The other important variable in this analysis was Body Mass Index but it was only important for divers who participated in over 90 dives per year. The more experienced the diver is and the higher his or her BMI, the less likely he or she is to stop diving. This result is tentative because of low sample size. Regardless of the low sample size, there appears to be a trend of the more experienced divers with a higher BMI being more reluctant to stop diving.

Research Recommendations for Stop Diving

These findings suggest a need for further studies. In future research it is recommended to acquire a much larger sample of active divers. Additionally it would be beneficial to conduct a longitudinal study with a group of divers to determine if their responses would change when cardiovascular conditions were actually present or if other conditions arose in which a physician determined it to be unsafe to continue diving.

Summary for Stop Diving

The logistic regression analysis on the important variables determined by the Classification and Tree analysis showed that there were no significant main effects or interactions. This suggests divers are not aware of the risks involved with cardiovascular conditions or they are aware of the risks and simply not willing to change their participation in the sport.

Final Summary and Implications for Future Research

Overall, the results of this study show that divers are continuing to dive regardless of their health conditions. These results certainly support the need for additional research. Additionally the results indicate a need for more education and awareness among individuals participating in dive training courses and well as active divers.

It is important when conducting a case-control study to have a large sample of both cases and controls in order to avoid some of the analytical problems that were encountered in this study. It is recommended to periodically check for singularities and variables with considerable overlap during the data collection process to confirm an appropriate sample size and variation in response. The results of this study indicate a need for future research. In addition to the larger sample size, possibly a longitudinal study related specifically to the diver's perceived risks and their willingness to stop diving if a physician tells them to stop diving. Other factors to be considered would be to conduct a study using a different measurement to determine the percent body fat of divers instead of using Body Mass Index. Although Body Mass Index is a convenient measurement when conducting an online survey, it is not the most accurate to determine body composition. Another factor to consider for future research is to ensure the sample includes those divers who are not fit in order to get more variation in the responses.

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APPENDICES

APPENDIX A: SCUBA SURVEY VERSION 3

No personal identifying information will be collected during this survey. All data will be kept confidential. Please answer as honestly and accurately as possible.

1. Please select your choice below. Clicking on the "agree" button below indicates that you have read and understand the purpose of this study and all information provided prior to clicking on this link to this survey:
• you voluntarily agree to participate
• you are at least 18 years of age

☐ Agree

☐ Disagree

2. What is today's date?

	MM		DD		YYYY
Today's date	Month	/	Day	/	Year

3. Are you:

☐ Male

☐ Female

4. How old are you?

Age

5. How tall are you?

Feet

Inches

6. What is your weight in pounds?

Weight in pounds [ ]

7. How many dives have you been on in the past year?

Number of dives [ ]

8. What is your highest level of certification?

[ ]

9. Please check the box next to the response below that best describes your current physical activity level.

- [ ] 1. I don't exercise or walk regularly now and I don't plan to start in the near future.
- [ ] 2. I don't exercise or walk regularly now but I've been thinking about starting.
- [ ] 3. I'm doing moderate physical activity fewer than five times a week or vigorous activity fewer than three times a week.
- [ ] 4. I've been doing moderate physical activity 5 or more days a week, or vigorous activity at least 3 days a week, for the last 1 to 6 months.
- [ ] 5. I've been doing moderate physical activity 5 or more days a week or vigorous activity at least 3 days a week, for 7 months or longer.

10. Have you ever had heart surgery?

- [ ] Yes
- [ ] No

11. Have you ever had blood vessel surgery?

- [ ] Yes
- [ ] No

12. Are you able to perform moderate exercise (example: walk 1.6 km/one mile within 12 minutes)?

- ☐ Yes
- ☐ No

13. Has a doctor or other health professional ever told you that you have high blood pressure?

- ☐ Yes
- ☐ No
- ☐ Don't Know

14. Do you take medication to control blood pressure?

- ☐ Yes
- ☐ No

15. Has a doctor or other health professional ever told you that you have heart disease?

- ☐ Yes
- ☐ No
- ☐ Don't Know

16. Have you ever had a heart attack?

- ☐ Yes
- ☐ No

17. Do you have a family history of heart disease? (Family history would include at least one grandparent, or at least one parent, or at least one aunt or uncle, or at least one brother or sister.)

- ☐ Yes
- ☐ No
- ☐ Don't Know

18. If you were diagnosed with a cardiovascular health condition in the future (heart disease, high blood pressure, previous heart attack, etc.), do you think your chances of dying while scuba diving are:

- ☐ High chance of dying
- ☐ Moderately high chance of dying
- ☐ Some chance of dying
- ☐ Almost no chance of dying

19. If you were told by a doctor that you were overweight, would you consider not diving until your weight was within an acceptable range?

- ☐ Yes
- ☐ No
- ☐ Don't know

20. If a doctor recommended you no longer dive due to a cardiovascular health condition, how likely is it that you would stop diving?

- ☐ Definitely
- ☐ Probably
- ☐ Probably Not
- ☐ Definitely Not

Thank you for participating in this survey.

Done

APPENDIX B: IRB APPROVAL FOR RELIABILITY STUDY

MIDDLE TENNESSEE STATE UNIVERSITY

September 13, 2012

Beverly Corlew, Norman Weatherby
Department of Health and Human Performance
Bev.Corlew@mtsu.edu, Norman.Weatherby@mtsu.edu

Protocol Title: "Reliability of SCUBA Survey"
Protocol Number: 13-054

Dear Investigator(s),

The exemption is pursuant to 45 CFR 46.101(b) (2). This is because the research being conducted involves the use of educational tests, survey procedures, interview procedures or public behavior.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting data and you are ready to submit your thesis and/or publish your findings. Should you not finish your research within the three (3) year period, you must submit a Progress Report and request a continuation prior to the expiration date. Please allow time for review and requested revisions. Your study expires on **September 13, 2015.**

Any change to the protocol must be submitted to the IRB before implementing this change. According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. **If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance before they begin to work on the project.** Once your research is completed, please send us a copy of the final report questionnaire to the Office of Compliance. This form can be located at www.mtsu.edu/irb on the forms page.

Also, all research materials must be retained by the PI or **faculty advisor (if the PI is a student)** for at least three (3) years after study completion. Should you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,
Andrew W. Jones
Graduate Assistant to:
Emily Born
Compliance Officer
615-494-8918
Emily.Born@mtsu.edu

APPENDIX C: IRB APPROVAL FOR DISSERTATION

Institutional Review Board
P.O. Box 124
Middle Tennessee State University
Murfreesboro, Tennessee 37132
Office: (615) 898-5005

MIDDLE TENNESSEE STATE UNIVERSITY

January 8, 2013

Beverly Corlew; Norman Weatherby
Protocol Title: Effects of Cardiovascular Conditions on Mortality among Scuba Divers
Protocol Number: 13-162

Dear Investigator(s),

The MTSU Institutional Review Board or its representative has reviewed the research proposal identified above. The MTSU IRB or its representative has determined that the study meets the criteria for approval under 45 CFR 46.110 and 21 CFR 56.110, and you have satisfactorily addressed all of the points brought up during the review.

Approval is granted for one (1) year from the date of this letter for **500** participants. Please use the version of the consent form with the compliance office stamp on it that will be emailed to you shortly.

Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.

You will need to submit an end-of-project report to the Office of Compliance upon completion of your research. Complete research means that you have finished collecting and analyzing data. Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date. Please allow time for review and requested revisions. Failure to submit a Progress Report and request for continuation will automatically result in cancellation of your research study. Therefore, you will NOT be able to use any data and/or collect any data.

According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to provide a certificate of training to the Office of Compliance. If you add researchers to an approved project, please forward an updated list of researchers and their certificates of training to the Office of Compliance (c/o Emily Born, Box 134) before they begin to work on the project.

All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.

Sincerely,

Aleka A. Blackwell

Aleka Blackwell
Member, MTSU Institutional Review Board

APPENDIX D: SCUBA SURVEY POSTING

Dear Diver,

You are being asked to participate in a study that involves research for partial fulfillment of a dissertation at Middle Tennessee State University. The following information is being provided to you as required by the Institutional Review Board.

1. The purpose of this case-control study is to examine the physical fitness levels and medical status of active divers and examine the relationship between cardiovascular health conditions and mortality while scuba diving. The secondary purpose of this study is to determine the extent to which those divers who do have pre-existing heart conditions perceive their risk of dying while diving and to determine the extent to which they are willing to change their diving behaviors.

2. After reading the information provided here within, you will be asked to follow a link provided by SurveyMonkey to the Scuba Survey. After agreeing to complete the survey, it should take approximately 5 minutes to complete the 20 question survey.

3. There are no foreseeable risks or discomforts anticipated in completing this survey.

4. The only benefit to you as the participant or others in completing this survey is to help with the research process.

5. There are no alternative procedures or courses of treatment.

6. All information is confidential – there are no personal identifiers associated with participating in this survey. All data collected will be kept in the locked office of the primary investigator for a period of 3 years following completion of the study.

7. Since there are no risks involved with participating in this online survey, no injury is expected and therefore no compensation is available in case of injury.

8. For questions please contact:
Dr. Norman Weatherby – Faculty Sponsor at [email address]
Ms. Beverly Corlew – Primary Investigator at [email address]
Compliance Office at [email address]
9. Participating in this research is strictly voluntary. There are no penalties for refusal or participate, and participation can be discontinued at any time without penalty or loss of benefits by closing the survey.
Please follow the link below. After following the link, you will be asked to once again agree that you have read and understand all information above, are at least 18 years of age and that you agree to voluntarily participate in the scuba survey. Thank you for your time.
https://www.surveymonkey.com/s/LG2B53V.