Prevalence of migraines in NCAA Division I men and women's basketball players

Chad Michael Kinart
University of Nebraska at Omaha

Follow this and additional works at: http://digitalcommons.unomaha.edu/studentwork

Recommended Citation
PREVALENCE OF MIGRAINES IN NCAA DIVISION I MEN AND WOMEN'S BASKETBALL PLAYERS

A Thesis
Presented to the
School of Health, Physical Education and Research
and the
Faculty of the Graduate College
University of Nebraska
In Partial Fulfillment
Of the Requirements for the Degree
Masters of Science
University of Nebraska at Omaha

By
Chad Michael Kinart

July 2000
THESIS ACCEPTANCE

Acceptance for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the Requirements for the degree Master of Science, University of Nebraska at Omaha.

Committee

[Signatures]

Chairperson [Signature]

Date July 12, 2000
ACKNOWLEDGEMENTS

I would like to first thank the Mid American Athletic Trainers Association Research and Education Committee for providing the funds to conduct this study. I would also like to thank Dr. Kris Berg, Dr. Jeff French, Dr. Monty Mathews and Mr. Tom Frette for their time and guidance in completing this project. I would especially like to thank Dr. Micki Austin for her support and direction throughout this project. Lastly, I would like to thank my family and girlfriend for putting up with me, not only during this project, but also with my migraines. For without the support and encouragement of those mentioned above, my study would not have been completed.
The purpose of this study was to describe the overall prevalence of migraines within NCAA Division I men and women's basketball players. In addition, the prevalence of migraines was determined across gender and ethnic groups for the same sample.

Seven hundred and ninety-one Division I men and women's basketball players representing 51 colleges and universities were mailed surveys asking questions about headaches. All surveys were analyzed with a validated diagnostic algorithm consistent with the International Headache Societies criteria for diagnosis. Descriptive statistics were used to report the prevalence rate for gender and ethnic groups as well as the entire sample. Chi square tests were performed (p = 0.05) to determine if there are any differences in the prevalence of migraines between gender and ethnic groups.

Results showed that 2.91% (n = 23 of 791) of the total population was classified as having migraines meeting IHS guidelines. In addition, 0.90% (n = 3 of 332) of males and 4.36% (n = 20 of 459) of females were classified as having migraines meeting IHS guidelines. Additionally, results showed that females reported migraines ($X^2 = 8.140, p = 0.004$) more often than males. When comparing the prevalence rates of migraines between ethnic groups, results showed that Caucasians had a rate of 3.26% (n = 14 of
While African Americans had a rate of 3.14% (n = 9 of 287). There was no significant difference found between ethnic groups in migraine prevalence ($X^2 = 2.491$, $p = 0.288$).

In conclusion, it was found that, 1) The prevalence of migraines in NCAA Division I men and women’s basketball players was generally less than what was seen for the general population, and 2) Females showed an increased prevalence of migraines when compared to males. Also, Caucasians and African Americans did not differ in prevalence of migraines.
# Table of Contents

<table>
<thead>
<tr>
<th>Chapter I: Introduction</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>5</td>
</tr>
<tr>
<td>Delimitations</td>
<td>5</td>
</tr>
<tr>
<td>Limitations</td>
<td>6</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>7</td>
</tr>
<tr>
<td>Significance of Study</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter II: Review of Literature</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis of Migraines</td>
<td>10</td>
</tr>
<tr>
<td>Prevalence of Migraines</td>
<td>13</td>
</tr>
<tr>
<td>Ethnicity and Migraines</td>
<td>14</td>
</tr>
<tr>
<td>Gender and Migraines</td>
<td>15</td>
</tr>
<tr>
<td>Exercise/Athletes and Migraines</td>
<td>16</td>
</tr>
<tr>
<td>Conclusion</td>
<td>23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter III: Methods</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>24</td>
</tr>
<tr>
<td>Data Collection</td>
<td>25</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>26</td>
</tr>
<tr>
<td>Figure I: Diagnostic Algorithm</td>
<td>26</td>
</tr>
<tr>
<td>Table I: Common Paths to Diagnosis</td>
<td>27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter IV: Results</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29</td>
</tr>
</tbody>
</table>
Table II: Characteristics of Subjects .......................................................29
Table III: Response to Survey Question #3 .............................................30
Table IV: Response to Survey Question #4 ..............................................30
Table V: Response to Survey Question #5 - #8 ........................................30
Table VI: Response to Survey Questions #9a - #9b .................................31
Table VII: Prevalence  .................................................................................31
Prevalence of Migraines Between Gender .....................................................31
Table VIII: Prevalence by Gender ............................................................32
Table IX: Chi Square Tests for Survey Questions – Gender ....................33
Table X: Chi Square Tests for Prevalence – Gender ....................................33
Prevalence of Migraines Between Ethnic Groups .........................................34
Table XI: Prevalence by Ethnicity ............................................................34
Table XII: Chi Square Tests for Survey Questions – Ethnicity ..................35
Table XIII: Chi Square Tests for Prevalence – Ethnicity ................................35
Chapter V: Discussion ..................................................................................36
Overall Prevalence of Migraines .............................................................36
Table XIV: Meta-Analysis of Prevalence Studies ........................................40
Prevalence of Migraines Between Gender ..................................................40
Prevalence of Migraines Between Ethnic Groups ..........................................42
Other Findings ..........................................................................................43
Limitations ..................................................................................................45
Suggestions for Future Research ...............................................................46
Chapter I
Introduction

Pain from headaches has been a subject of concern for thousands of years (Forgays, Rzewnicki, Ober, & Forgays, 1993). Headaches are a common disorder characterized by intermittent and/or chronic pain, which imposes significant limitations on functioning and quality of life (Solomon, Skobieranda, & Gragg, 1993). Contrary to popular belief, migraines are a very specific type of headache. Migraines result from abnormal cerebral vascular activity (Lambert & Burnet, 1985). They are an episodic disorder whose diagnosis rests largely on the evaluation of symptoms which sufferer’s report retrospectively (Silberstein & Lipton, 1993). Because the identification of a migraine relies almost entirely on subjective symptoms reported by patients, the process of definitive diagnosis is very difficult. The Headache Classification Committee of the International Headache Society (IHS) (1988) developed strict guidelines to help physicians and researchers diagnose migraines more objectively. Before the guidelines from the IHS became available, researchers and clinicians used one of several classification systems or created their own. This made the comparison of studies and diagnosis very difficult.

The diagnosis of a migraine according to IHS guidelines is very strict. If a patient’s symptoms do not meet IHS criteria, the pain is termed as one of many other variations of a headache. The old classification defined a “classic” migraine as presenting with an aura and a “common” migraine presenting without an aura. As defined by the IHS (1988), migraines are now classified as either with or without an
aura. An aura is a subjective symptom characterized by flashes of light and/or a narrowing of the patient’s field of vision. This feature was deemed necessary within the old classification system as a major distinguishing feature (IHS, 1988). The new system takes into account not only the number of symptoms, but the interaction of all symptoms present.

Migraines have been estimated to affect 8.7 million females and 2.6 million males in the United States (Osterhaus, & Townsend, 1991) at an estimated cost of 6.5 to 17.2 billion dollars a year (Osterhaus, Gutterman, & Plachetka, 1990). In addition, a recent study found that only 66% of 20,468 respondents of a questionnaire had ever consulted a doctor for their migraine (Lipton, Stewart, & Simon, 1998).

Researchers have found a consistent difference in the prevalence of migraines between men and women, but the reason is still unknown why women have an increased prevalence (Stang & Osterhaus, 1993). Although scientifically unproven at this time, fluctuations in sex hormones during menstruation have been postulated to account for the increased prevalence in women (Silberstein & Merriam, 1991). Swain and Kaplan reported that migraines can be triggered by the onset of menses and are traditionally more disabling and less responsive to medical treatment than those triggered by other factors (1997).

It has also been noted that Caucasians differ significantly in their susceptibility to migraines than do African-Americans and Asian-Americans, which probably stems from inherited differences (Stewart, Lipton, & Liberman, 1996). Additionally, depression has been linked to the higher prevalence of migraines in Caucasians. It has
been reported that Caucasians have a higher prevalence of reported depression than African- and Asian Americans (Stewart, Lipton & Liberman, 1996). Certain food products and chemicals have been found to trigger migraines. Stewart, Lipton, and Liberman (1996) report that dietary phenols in certain foods are processed differently within the body between ethnic groups and could help explain some of the difference in prevalence between ethnic groups.

A wide discrepancy in the prevalence of migraines can be found in review of the current literature. This is due to variations in case definitions, study methods, socio-demographic characteristics and adherence to case definitions when diagnosing (Stewart, Simon, Shechter & Lipton, 1995). Few studies use the same methods when determining prevalence of migraines. With differences being reported within gender, ethnic, geographic, and different-aged populations that can affect the prevalence, studies that are not the same within these parameters will probably yield different results. In addition, a majority of the studies in the literature at the present time were conducted with the old migraine classification guidelines. The old guidelines were subjective and incomplete when compared to the IHS guidelines. This makes comparing data very difficult.

Physicians have numerous options when treating migraines. The typical method for treating a migraine is to use medications and lifestyle modifications to induce positive changes in migraine patterns. One of the methods used in conjunction with medication to help migraine sufferers is exercise (Darling, 1991). The literature is divided on the value of exercise in helping migraine symptoms. Lambert and Burnet
(1985) presented a case study to implicate exercise in the triggering of migraines. They found that a proper warm-up would decrease the chance of an athlete getting a headache/migraine. Effort migraines or headaches have been reported to occur after intense exercise, mainly at higher altitudes and in athletes who are in poor physical condition (Atkinson & Appenzeller, 1981). Athletes in a state of hypoglycemia may be more susceptible to the onset of migraines (Atkinson & Appenzeller, 1981). In contrast, work done by Lockett & Campbell showed that exercise decreases the amount of pain and distress the patients perceive from the migraine (1992). An extensive review of the literature by Darling (1991) revealed that exercise in most patients might be a very useful tool in the reduction of their migraines. One could deduce from Darling's research that if exercise reduces the prevalence of migraines, then one would expect to see a decreased prevalence within an athletic population.

Although there have been numerous studies done on the prevalence of migraines within the general population, college students, professional groups, industrial/work place settings, and overseas populations, little has been done with athletes (Stewart, Simon, Shechter, & Lipton, 1995). It has also been reported that migraines cause depression, insomnia, fatigue, anorexia, nausea, and vomiting (Dalessio, 1994). All of these things can hinder athletic performance in and of themselves. Sports medicine physicians agree that athletes in virtually every sport incur migraines. They also agree that the majority of migraines are benign inconveniences that reduce time on the practice/game field and hamper performance (McCarthy, 1988). Sports medicine clinicians and researchers also agree that migraines in athletes are
probably underreported and often misdiagnosed (McCarthy, 1988). Many medications commonly used to treat headaches can negatively affect an athlete’s performance. Therefore, treatment choices must take into consideration any physical and/or sensory impairments of the treatment regime (McCarthy, 1988). However, there is still a controversy on whether or not exercise helps or causes migraines.

It is expected that athletes will have fewer complaints of headaches due to natural selection at the level in which they are competing. In addition, sports medicine professionals must consider the special nature of headaches in athletes and learn how to treat them without compromising their performance (McCarthy, 1988).

**Purpose**

The purpose of this study is to describe the overall prevalence of migraines within NCAA Division I men and women’s basketball players. In addition, the prevalence of migraines will be described across gender and ethnic groups within the sample.

**Delimitations**

The study will be conducted by a survey mailed to 200 randomly selected Division I universities that have men and women’s basketball programs. The population of subjects will come from the current rosters of the men and women’s basketball teams. Those players who suffer from headaches related to a recent concussion and/or chronic illness will not be included in the sample. They will be asked to preclude themselves from the study by not filling out the survey.
Limitations

Major limitations of the current study are the rate of return of the survey, accuracy of the subject’s answers, and adherence to the definition of a “migraine” used in the study. The problem of having a low return rate will be handled by having the surveys sent directly to the head athletic trainer at each institution to increase the return rate. The survey will be short (10 questions) and easy to complete (yes/no questions), expediting the return. A pre-paid mailer will be included for return of the survey. A second letter/phone call will be used if there has been no response by the initial survey return deadline.

Another limitation is the accuracy in which subjects answer the questions. The large sample size may decrease the effect of a few incorrect questionnaires. All questions are short, specific, and have been validated in a previous study (Henry, Brochet, Dartigues, Tison, Salamon, & GRIM, 1992). The survey being used in the current study has been validated and has an accompanying algorithm to assist the researchers in the process of diagnosing a migraine from self-reported questionnaire data.

The last major limitation is the adherence to the definition of a “migraine” used in the current study. If the definition is not strictly held to, the prevalence rate will not be correct. This is due to the inclusion of subjects that report a migraine when it should be classified as a headache and vice versa.
Definition of Terms

Definitions used in the study that may be confusing, are the following:

*Photophobia* is an abnormal sensitivity to light, *phonophobia* is an abnormal sensitivity to sound, *unilateral* pertains to occurring on only one side, and *aura* pertains to visual disturbances and flashes of light. Within this study, a “migraine” will be defined following the guidelines published by the Headache Classification Committee of the International Headache Society (1988).

1. Migraine with aura
   a. At least two attacks fulfilling the following criteria
   b. At least three of the four following characteristics
      1. One or more fully reversible aura symptoms
      2. At least one aura symptom develops gradually over more than four minutes or two or more symptoms occur in succession
      3. No aura symptom lasts more than 60 min
      4. Headache follows aura with a free interval of less than 60 minutes
   c. At least one of the following
      1. History, physical, and/or neurologic exam does not suggest another disorder causing the headache
      2. History, physical, and/or neurologic exam suggest another disorder that is ruled out by appropriate investigation
      3. Another disorder is present, but migraine attacks do not occur for the first time in close temporal relation to the disorder
2. Migraine without aura

   a. At least five attacks fulfilling the following criteria
   
   b. Headache lasting 4 to 72 hours
   
   c. Headache has at least two of the following
      1. Unilateral location
      2. Pulsating quality
      3. Moderate or severe intensity
      4. Aggravation by walking, using stairs, or any routine activity
   
   d. During the headache at least one of the following
      1. Nausea and/or vomiting
      2. Photophobia and phonophobia
   
   e. At least one of the following
      1. History, physical, and neurologic examinations does not suggest another disorder causing the headache
      2. History, physical, and/or neurologic examinations do suggest another disorder, but is ruled out by appropriate investigation
      3. Such disorder is present, but migraine attacks do not occur for the first time in close temporal relation to the disorder

**Significance of Study**

This study will help describe the prevalence of migraines within an athletic population. The ramifications of the findings are several. First, it will begin to give insight into the occurrence of migraines in NCAA Division I basketball players across
ethnic and gender groups. In addition, a study looking at athletes has not been previously done. Lastly, the current study may stimulate research on migraines.
Chapter II

Review of Literature

Migraines have been studied extensively within the current literature. However, the direct relationship between athletes/exercise and migraines has not been covered very thoroughly in the literature. The following topics will be covered: diagnosis, prevalence, ethnicity, gender, and exercise/athletes in migraines.

Diagnosis of Migraines

The diagnosis of a migraine has been a subject of controversy among physicians for many years. Since the majority of symptoms are subjective in nature, a large part of the diagnosis rests on the patient’s subjective history. A migraine episode can be divided into five different phases: prodrome, aura, headache, headache termination, and postdrome (Saper, 1997). The majority of people only experience a couple of the phases, but some have all five phases identifiable during their attack (Saper, 1997). The prodrome phase is when the person gets subtle symptoms that signal an on-coming migraine. Symptoms exhibited in this phase are changes in mood, stiff neck, fatigue, constipation, and/or food cravings. The next phase is the aura. It typically involves focal neurologic symptoms over a 5-20 minute period of time and can be visual, motor, and/or sensory in nature. Aura symptoms may include any of the following: light sensitivity, tinnitus, paresthesia, and unformed flashes of light. Following the initiation of an aura, the headache phase is the period of time when the patient will experience the majority of his/her pain. Commonly, the aura phase and the headache phase occur at the same time. The next phase is the termination phase, when the headache tapers and eventually
ceases. The last phase is the postdrome phase and is characterized with fatigue, listlessness, and a washed-out feeling. The patient may also become irritable and have problems concentrating.

In 1988, the Headache Classification Committee of International Headache Society (IHS, 1988) released a comprehensive set of classifications for all types of headaches. The classification is as follows:

1. Migraine with aura
   a. At least two attacks fulfilling the following criteria
   b. At least three of the four following characteristics
      1. One or more fully reversible aura symptoms
      2. At least one aura symptom develops gradually over more than four minutes or two or more symptoms occur in succession
      3. No aura symptom lasts more than 60 min
      4. Headache follows aura with a free interval of less than 60 minutes
   c. At least one of the following
      1. History, physical, and/or neurologic exam does not suggest another disorder causing the headache
      2. History, physical, and/or neurologic exam suggest another disorder that is ruled out by appropriate investigation
      3. Another disorder is present, but migraine attacks do not occur for the first time in close temporal relation to the disorder

2. Migraine without aura
a. At least five attacks fulfilling the following criteria

b. Headache lasting 4 to 72 hours

c. Headache has at least two of the following
   1. Unilateral location
   2. Pulsating quality
   3. Moderate or severe intensity
   4. Aggravation by walking, using stairs, or any routine activity

d. During the headache at least one of the following
   1. Nausea and/or vomiting
   2. Photophobia and phonophobia

e. At least one of the following
   1. History, physical, and neurologic examinations does not suggest another disorder causing the headache
   2. History, physical, and/or neurologic examinations do suggest another disorder, but is ruled out by appropriate investigation
   3. Such disorder is present, but migraine attacks do not occur for the first time in close temporal relation to the disorder

This classification gave physicians a widely accepted definition to use when trying to differentiate a migraine versus another headache disorder. The IHS (1988) defined several distinguishing features of migraines within their clinical criteria. They are: at least five attacks (without aura) or at least two attacks (with aura), headache lasting 4 to 72 hours, unilateral location of pain, pulsating quality, moderate to severe
intensity, nausea, vomiting, photophobia, phonophobia, and no other underlying
disorder causing the pain. When using the IHS criteria to diagnose, specific
combinations of symptoms must be present to be diagnosed with a migraine. Before
the IHS criteria became available, physicians used several different loosely organized
models to diagnosis migraines.

Even though the diagnosis is commonly made through subjective accounts from
the patient, a primary physical examination is still performed. Dalessio (1994) stated
that when diagnosing a migraine, the main purpose of the primary examination is to
rule out any systemic causes of headache pain, even though most patients will present
with normal physical and neurologic signs during the primary exam. Swain and Kaplan
(1997) suggest that a comprehensive physical examination be done to rule out possible
serious causes of pain before a diagnosis is made. The physical examination should
include a blood pressure check, complete eye exam, ear-nose-throat (ENT) exam,
assessment of the temporomandibular joint (TMJ), neck exam, neurologic exam,
assessment of depression/life stressors, and questions regarding problems and/or
staleness in training. Special diagnostic testing is very seldom necessary in diagnosis,
but medical-legal concerns often dictate that imaging studies be conducted to rule out
more serious neurologic problems (Swain & Kaplan, 1997).

Prevalence of Migraines

There are numerous prevalence studies reported in the literature. The majority
of studies pertain to different groups within the general population. Since populations
in other countries have different lifestyles and reside in different geographic locations,
only studies conducted in the United States will be reviewed. Stewart, Lipton, Celentano, & Reed found that the prevalence of migraines in the United States was 17.6% for females and 5.7% for males (1992). Another study by Lin et al., Stewart, Celentano, Ziegler, and Spreencher (1989) looked at the prevalence of migraines in subjects located in Washington County, Maryland. They found that of the 10,169 subjects surveyed, 3.0% of the males and 7.4% of females fell into the migraine category. Stang and Osterhaus (1993) found through the National Health Interview Survey that the overall estimated prevalence of migraines in the US was 4.1%.

As can be found in the literature, there is a wide discrepancy in the prevalence of migraines. Stewart, Simon, Shechter & Lipton (1995) found in a meta-analysis of variation in migraine prevalence that 70% of the variation occurred from differences in gender, age and case definition within the studies. Even though the IHS criterion has helped research in the last 10 years, it is still open to interpretation. Henry et al. (1992) reports the prevalence of migraines in two different ways. In the first way, they reported the prevalence holding strictly to the criteria. The second way is reported holding to the criteria more loosely. Prevalence was reported in this manner due to patients within their study not conforming to the IHS guidelines, but still having migraines. By reporting prevalence both ways, it is easier to compare data across different studies.

Ethnicity and Migraines

Some researchers have suggested that race is an important factor in determining the prevalence of migraines in a population. Stewart, Lipton, and Liberman (1996)
found that the prevalence of migraines in African Americans and Asian Americans were lower than what was found in Caucasians in a validated telephone survey conducted in Baltimore County, Maryland using 12,328 eligible subjects. Similarly, Stang and Osterhaus (1993) found the number of migraines reported in their study of National Health Interview Survey data was significantly lower for African- and Asian-Americans (p<0.01) than for Caucasians. Stewart et al. (1996) suggested that the differences in prevalence could be attributed to inherited factors between races. For example, depression and problems with serotonin metabolism have been linked with migraines and been found to be lower in Asian-Americans than in Caucasians. Also, the metabolism of dietary phenols in the body has been found to be different between African/Asian Americans than in Caucasians (Stewart et al., 1996). At the current time, it is not clear why there is a difference in prevalence. This is an area where further research needs to be conducted.

Gender and Migraines

According to the literature reviewed, prevalence of migraines in males and females has been found to differ. A telephone interview of 10,169 subjects between the ages of 12-29 in Washington County, Maryland found that 3.0% of males and 7.4% of females suffered from migraines as determined by the IHS criteria (Linet, Stewart, Celentano, Ziegler, & Sprecher, 1989). Similarly, Stewart, Lipton, Celentanro, and Reed (1992) conducted a study to determine the prevalence of migraines in the U.S. They obtained 20,468 responses from participants aged 12 to 80 years old and found that 17.6% of the females and 5.7% of the males conformed to the IHS criteria for
migraines. Lastly, Stang and Osterhaus (1993) found that only 5.7% of females and 2.3% of males suffered from migraines. They obtained their data from 47,711 households in 1989 using the survey information included in the National Health Interview Survey tool. The researchers ended up with 116,929 subjects that correctly completed the survey.

An explanation for the increased prevalence of migraines in females presented in the literature has been estrogen levels during menstruation. Migraines due to the onset of menses can be more disabling than migraines triggered by something else (Swian and Kaplan, 1997). The literature currently does not have a clear explanation for difference in prevalence between gender.

**Exercise/Athletes and Migraines**

When treating migraines, exercise is one of the most common methods recommended by the attending physician. Anecdotal evidence from many people shows that sufferers get relief through exercise (Darling, 1991). There is however, literature that refutes the fact that exercise can help migraines. Exertional headaches have been reported to be a problem among some athletes with the proposed cause being a vasodilation of cerebral vessels (Perry, 1985). Vasodilation during exercise has been speculated to be caused by the release of prostaglandins (Perry, 1985). In addition, Massey (1982) reported three case studies of effort headaches in runners. He reported from these cases that exhaustive exercise can result in a headache (Massey, 1982). The pathophysiology that has been proposed to cause this revolves around cerebral vasoconstriction, edema, subsequent hypoxia, and hyperventilation.
Stress from physical exertion seems to be the central factor in four cases of exertional headache presented by Perry (1985). Some research reports that migraines decrease performance. In 1997, Neusub, Neumann, Steinhoff, Thegeder, Bauer, and Reimers found in their study of 145 control subjects and 22 migraine/headache subjects 16 to 82 years old, that aerobic endurance was reduced in both males and females with a history of migraines (p<0.05 and p<0.01). It was also found that flexibility was decreased and body fat was increased in females (p<0.05) when compared to healthy controls. Cho, Clark, & Rupert (1995) reported a case study of a 31 year-old helicopter pilot who suffered from visually triggered migraines. The patient performed significantly worse on spatial orientation and balance tests compared to normative data. He was free from other medical problems and had to be “re-assigned” from flight duty due to the seriousness of his problems. This case shows that migraine sufferers can have significant balance and orientation problems while suffering from an attack.

In a study of 12 migraine sufferers with aura and 12 matched healthy controls, Wray, Mijovic-Prelec, & Kosslyn (1995) looked at visual processing ability. The researchers employed two low-level visual tasks (orientation search and temporal order judgement) and two high-level visual processing tasks (picture naming and word priming). It was found that migraine sufferers performed significantly better in the low-level tasks when compared to the 12 matched controls (p < 0.04 for the orientation search task and p < 0.03 for the temporal order judgement task). When tested in high-level visual processing tasks, migraine sufferers performed significantly lower than matched controls in high-level visual processing tasks. Bruyn, Bootsma, and Klawans
(1976) published a case report on a retired airplane telegrapher who experienced bradycardia during cluster headaches. The average resting heart rate of the patient was 66 to 70 beats per minute while his heart rate was 20 to 44 beats per minute during his attacks (Bruyn et al., 1976).

Evers, Bauer, Suhr, Husstedt, & Grotemeyer (1997) conducted a study on cognitive processing in a variety of headache disorders. The investigators examined 233 patients with headache disorders according to criteria determined by the IHS. Cognitive function was determined by looking at event-related potentials. Subjects were instructed to look at a video screen and push a button with their dominant hand if a red dot appeared on the screen, and ignore a white dot. EEG measurements were taken during all trials. It was found that migraine sufferers failed to habituate between trials and performed significantly worse when compared to healthy controls (Evers et al., 1997).

Ambrosini, de Noordhout, Alagona, Dalpozzo, & Schoenen (1999) conducted a study looking at neuromuscular transmission in migraine patients. They reported mutations in the P/Q Ca-Channels within the central nervous system in patients with familial hemiplegic migraine. If this is the case, the researchers hypothesized that neuromuscular transmission should be impaired in the general migraine sufferer. They performed single fiber electromyography (SFEMG) on a group of 19 patients (six males and 13 females) that suffered from migraines with an aura as diagnosed by the IHS. Scores obtained from the experimental group were compared to a control group of 14 healthy controls (six males and eight females). It was found that the mean value
of consecutive differences (MCD) were significantly higher in the migraine group when compared to the controls \( (p < 0.034) \). It was also found that 10 of the 19 migraine patients had abnormal SFEMG finding (Ambrosini et. al., 1999).

Hassinger, Semenchuk, & O' Brien (1999) conducted a study on the cardiovascular responses to pain and stress in those who experience migraines. The experimental group contained 26 females that fit the IHS criteria for migraines recruited from a group of 600 introductory psychology students. The control group contained 26 females from the same experimental group who experienced very few headaches. All subjects were subjected to cold pressor and mental arithmetic tasks while cardiovascular and pain measures were being taken. All subjects were brought into a room and were instructed to sit quietly in a chair for 10-minutes for the adaptation phase. Next, participants relaxed quietly for five minutes while resting baseline measures were taken for Baseline I. After that, subjects were randomly subjected to either a physical or cognitive stressor for three minutes. Then, a five-minute recovery period was employed, where the patients would sit quietly and relax as much as possible. Second sets of baseline measures were taken before all patients would undergo whichever stress test they did not participate in the first time. To end the procedure, a five-minute recovery period was used to collect data from the second set of stressor testing. The researchers found no significant difference in the mean scores of the cardiovascular tests. An overall difference between the migraine and headache-free group was observed in the mean scores, but were not significant and the source could not be identified. In addition to the previous findings, Hassinger et al.,
(1999) found that the cardiovascular recovery periods showed significant differences between the two groups. The researchers found that migraine sufferers returned to a significant higher total peripheral resistance (TPR) \( (p = .035) \), and lower stroke volume (SV) \( (p = .008) \), and a lower cardiac output (CO) \( (p = .006) \) than healthy controls.

Kohler and Kosanic (1992) conducted a study to determine if migraine sufferers had a higher degree of ambition, orderliness, and rigidity than healthy controls. Sixty-nine pairs of subjects were recruited from a neurologic and psychiatric practice in Hildesheim, Germany and given a personality test that has been previously used by investigators in practice. It was found that although the migraine sufferers had slightly higher scores than the healthy controls, the differences were far from significant. Therefore, the researchers concluded that migraine patients do not differ in the personality traits ambition, orderliness, and rigidity when compared to healthy controls (Kohler et al., 1992).

Von Korff, Stewart, Simon, & Lipton (1998) conducted a study to determine the amount of lost workdays and performance due to migraines. Subjects were found through a telephone survey in Baltimore County, MD. All eligible subjects recorded his/her migraine accounts in diaries provided by the investigators for 13 weeks. It was found that the participants reported an average of 2.2 workdays lost with migraine headaches. The majority of the lost workdays were due to a decrease in performance and not being absent (Von Korff et al., 1998).

Although some of the literature has shown that migraines can decrease components of physical performance, exercise has continued to be prescribed for
migraine sufferers. Simons, Solbach, Sargent, & Malone (1986) reported the use of a wellness program in their treatment of headaches at the Headache Center of the Menninger Foundation in Topeka, Kansas. Their program began with a one- to two-hour discussion of seven different topics. The topics discussed included the following: patient’s expectations, stating that headaches have more than one cause and therefore more than one treatment, discussed treatment options, suggested more than one treatment option to increase their chance to get relief, talked about realistic expectations on relief/recovery, and that the patient must take responsibility of their care for the plan to work. Aerobic exercise was part of the program, as this type of exercise encourages the release of beta-endorphins that help to control pain. Lockett et al., (1991) looked at the effects of aerobic exercise on migraines and found that those who improved their cardiovascular fitness, retrospectively reported their migraines as being less painful and distressing.

The majority of headaches reported by athletes and/or active people are normally benign in nature (McCarthy, 1988). This means that the migraine is not a terminal problem or something that would predispose them to further health problems. The incidence and prevalence of sports-related headaches are un-known due to few studies on this topic (McCarthy, 1988). Physicians expect athletes to have fewer complaints of headache pain, but they still need to consider the special nature of this problem and learn how to treat them without compromising their performance (Swain & Kaplan, 1997). Treatment of migraines by non-pharmacologic methods can be helpful in minor conditions and/or in conjunction with medication (Swain & Kaplan,
This therapy can be any of the following: hot/cold therapy, massage, biofeedback, relaxation techniques, regular aerobic exercise, avoiding fasting, and obtaining appropriate amounts of sleep (Swain & Kaplan, 1997). A study conducted by Lockett and Campbell (1992) showed that those subjects that improved their aerobic fitness reported a decrease in the severity of their migraines over the control group.

Exercise has been suspect to cause migraine symptoms. The current literature simply shows a decrease in certain abilities key to performance, not that exercise causes migraines. But only case studies exist at this time. No current scientific studies document that exercise causes migraine symptoms. Case studies conducted at the 1968 Mexico City Olympics showed that elite athletes at sea level could train or race under extreme stress without exercise induced migraines, but developed migraines in Mexico City. This was speculated to be due to the high altitude and lack of oxygen. It was found anecdotally that a careful warm-up prevented exercise induced migraine in these athletes (Lambert & Burnet, 1985). Atkinson and Appenzeller (1981) reported that athletes who were out of shape experienced an increased incidence of effort migraines. Also, hypoglycemia has been suspected to induce effort migraines if a meal is not eaten prior to a workout or competition (Atkinson & Appenzeller, 1981). As can be seen, there is evidence that exercise that is not carried out in ideal conditions may increase chances of a migraine occurring.
Conclusion

Migraines are prevalent throughout the population of the United States. They affect both genders and people of all races, but occur at different rates. Females experience migraines more than males, but the literature does not indicate a clear reason for this difference. In addition, African and Asian-Americans experience fewer migraines than Caucasians. Exercise is being used to treat and control migraines, but there are limited studies looking directly at this. The literature provides some indirect support to the premise that exercise may cause migraines. Exercise is still being used successfully in the management of migraines even though we don't totally understand the reasons why. Knowing how many athletes that may be subject to migraines will allow sports medicine professionals better care for those who are troubled by them. More comprehensive treatment programs may need to be developed to allow the afflicted athlete to perform at his/her peak.
Chapter III

Methods

The purpose of this study is to describe the overall prevalence of migraines within NCAA Division I men and women’s basketball players. In addition, the prevalence of migraines will be described across gender and ethnic groups within the same sample.

Subjects

Eligible participants in the current study included 200 NCAA Division I men and women’s basketball teams (n = 6000, 30 surveys to each school with 15 sent to each team). The sample of 791 subjects included only those athletes on the active roster of each team during the 1999-2000 season. All subjects were required to be free from chronic illness. This information was self-reported by the subjects and were asked to exclude themselves from filling out the survey if currently suffering from chronic illness concussion related headaches. Also, subjects could not be experiencing headaches resulting from concussions or any other conditions. Two hundred teams were randomly selected from all Division I universities that sponsor men and women’s basketball. Mailing labels were obtained from the National Collegiate Athletic Association (NCAA). Random assignment was achieved by assigning each school a number and then having a random number generator choose which schools to include. Informed consent was implied if the athlete filled out and returned the survey. Approval was granted to conduct the study from the Nebraska State Institutional Review Board prior to the mailing of questionnaires.
Data Collection

The head athletic trainer at each of the randomly selected Division I universities was mailed surveys to administer to his/her men and women's basketball teams. The survey (Appendix A) being used in the current study was modified slightly from the one validated by Henry, Michel, Brochet, Dartigues, Tison, and Salamon (1992) in a nationwide survey of the prevalence of migraines in France. The original survey (Appendix B) was found to have a sensitivity for the diagnosis of migraine of 95% and a specificity of 75% (Henry et al., 1992). Sensitivity refers to the proportion of subjects that test positive for a condition for which that test is intended to reveal. In addition, specificity refers to the proportion of individuals that would test negative for a condition that the said test is supposed to reveal. All questions were developed from the International Headache Societies (1988) criteria for the classification and diagnosis of headaches. Before completing the survey, athletes were read a brief, generic description of the study and its purpose (Appendix C). Those subjects, who answered question #1 with a “no”, were instructed to not go any further with the survey. This was due to the fact that the rest of their answers would also be “no.” All surveys were returned using the provided self-addressed stamped envelope with no individual names and/or markings on them. Surveys that were not completed correctly were omitted from the sample. A follow-up letter was mailed to those universities that had not returned their surveys by the specified deadline. An additional mailing was necessary to elicit the responses needed for a successful study. Results of the study were sent to all schools who participated, if requested.
Data Analysis

Prevalence of migraines was derived from data provided by correctly returned surveys. The researcher determined if responses in each survey fit the IHS criteria for a migraine using the algorithm (Figure I) supplied with the validated survey used by Henry et al. (1992).

Figure I Diagnostic Algorithm
A "yes" answer on a question moved the respondent on to the next decision making point in the algorithm. Questions answered with a "no" would move the respondent to another point. This would continue until the subject reached an endpoint, which was a diagnosis (Figure I). To be diagnosed with an IHS migraine, borderline migraine, possible migraine, or a non-migraine headache, each subject's set of symptoms had to point to that specific diagnosis through the algorithm. For example, to be diagnosed with an IHS migraine, several distinguishing symptoms needed to be present. They are the following: at least five attacks (without aura) or at least two attacks (with aura), headache lasting 4 to 72 hours, unilateral location of pain, pulsating quality, moderate to severe intensity, nausea, vomiting, photophobia, phonophobia, and no other underlying disorder causing the pain (IHS, 1988).

Table I  Common Paths to Diagnosis

<table>
<thead>
<tr>
<th></th>
<th>IHS Migraine</th>
<th>Borderline Migraine</th>
<th>Possible Migraine</th>
<th>Non-Migraine Headache</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have headaches?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Do you have headaches every day?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>How long do your headaches last?</td>
<td>4-72 hrs</td>
<td>4-72 hrs</td>
<td>&gt; 72 hours</td>
<td>&gt; 72 hours</td>
</tr>
<tr>
<td>Location of headaches?</td>
<td>-</td>
<td>-</td>
<td>Alternately</td>
<td>Strictly one side</td>
</tr>
<tr>
<td>Throbbing headache?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Headaches inhibit daily activity?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>Headaches get worse with activity?</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Nausea/vomiting?</td>
<td>Yes</td>
<td>No</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Light sensitivity?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Sound sensitivity?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>More than four lifetime episodes?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

The diagnosis of a borderline migraine, possible migraine, and non-migraine headache through the algorithm (Figure I) is more complicated than a diagnosis of an
IHS migraine. Diagnosis of an IHS migraine has one distinct path within the algorithm (Figure I). To come to a diagnosis of any of the other types of headaches, several different paths for each diagnosis will have been followed. Table I depicts the most common paths taken to each of the different classifications used.

Descriptive statistics were used to describe the prevalence rates for each question and for gender and ethnic background as a sub-sample. Because Caucasians and African Americans accounted for the majority of the sample, all of the remaining ethnic groups were put into the “other” category for data analysis purposes. Chi square tests were preformed (p = 0.05) to determine if there were differences in the prevalence of migraines between gender and ethnic groups. In addition, chi square tests were used to analyze differences between gender and ethnicity in response to each of the 10 questions.
Chapter IV

Results

The purpose of this study was to describe the prevalence of migraines in NCAA Division I men and women’s basketball players. Seven hundred and ninety-one Division I men and women’s basketball players representing 51 colleges and universities returned correctly completed surveys. Surveys were sent to 200 randomly selected colleges/universities with 30 questionnaires for each school (15 for men, 15 for women). Seven hundred and ninety-one correctly completed surveys were returned resulting in 13.2% (n = 791 of 6000) return rate. Descriptive characteristics of all subjects can be found in Table II.

Table II Characteristics of Subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>% of Total</th>
<th>n</th>
<th>Mean Age</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>54.2%</td>
<td>429</td>
<td>20.14</td>
<td>1.57</td>
<td>18-29</td>
</tr>
<tr>
<td>African American</td>
<td>36.3%</td>
<td>287</td>
<td>20.25</td>
<td>1.44</td>
<td>18-26</td>
</tr>
<tr>
<td>Native American</td>
<td>3.7%</td>
<td>29</td>
<td>20.52</td>
<td>1.40</td>
<td>18-23</td>
</tr>
<tr>
<td>Other</td>
<td>2.5%</td>
<td>20</td>
<td>20.95</td>
<td>1.43</td>
<td>18-23</td>
</tr>
<tr>
<td>Multi-Racial</td>
<td>1.6%</td>
<td>13</td>
<td>19.78</td>
<td>1.30</td>
<td>18-22</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>1.4%</td>
<td>11</td>
<td>19.64</td>
<td>0.92</td>
<td>18-21</td>
</tr>
<tr>
<td>Asian</td>
<td>0.3%</td>
<td>2</td>
<td>25.50</td>
<td>3.54</td>
<td>23-28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>791</strong></td>
<td><strong>20.21</strong></td>
<td><strong>1.53</strong></td>
<td><strong>18-29</strong></td>
</tr>
</tbody>
</table>

Of the 51 colleges/universities that responded to the survey, 791 correctly completed questionnaires were returned. Question #1 of the survey asked subjects, “Are you subject to headaches?” It was found that 53.98% (n = 427 of 791) of the sample reported to be subject to headaches. Question #2 asked, “Do you suffer from
headaches every day?” It was found that 7.96% (n = 34 of 427) of those suffering from headaches had them every day.

Questions #3 and #4 asked all subjects “How long do your headaches last without medication?” and “What is the usual location of your headache?” Results for all subjects can be found in Tables III and IV. Questions #5 through #8 asked about general symptoms of headaches. The results can be found in Table V.

Table III  Response to Survey Question #3

<table>
<thead>
<tr>
<th>How long do your headaches last without medication?</th>
<th># of responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 hours</td>
<td>209 of 427</td>
<td>48.5%</td>
</tr>
<tr>
<td>&gt; 72 hours</td>
<td>6 of 427</td>
<td>1.41%</td>
</tr>
<tr>
<td>4-72 hours</td>
<td>131 of 427</td>
<td>30.48%</td>
</tr>
<tr>
<td>Do not know</td>
<td>81 of 427</td>
<td>19.97%</td>
</tr>
</tbody>
</table>

Table IV  Response to Survey Question #4

<table>
<thead>
<tr>
<th>What is the usual location of your headache?</th>
<th># of responses</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strictly one side of the head</td>
<td>49 of 427</td>
<td>11.48%</td>
</tr>
<tr>
<td>Alternately in the right and left part of head</td>
<td>182 of 427</td>
<td>42.62%</td>
</tr>
<tr>
<td>Other location</td>
<td>127 of 427</td>
<td>29.74%</td>
</tr>
<tr>
<td>Do not know</td>
<td>69 of 427</td>
<td>16.16%</td>
</tr>
</tbody>
</table>

Table V  Response to Survey Questions #5 through #8

<table>
<thead>
<tr>
<th># of “Yes” answers</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throbbing type of headache?</td>
<td>328 of 427</td>
</tr>
<tr>
<td>Do your headaches inhibit or prevent daily activities?</td>
<td>88 of 427</td>
</tr>
<tr>
<td>Do your headaches get worse during physical activity?</td>
<td>182 of 427</td>
</tr>
<tr>
<td>Accompanied by nausea and/or vomiting</td>
<td>67 of 427</td>
</tr>
</tbody>
</table>
Questions #9a and #9b asked all subjects if their headaches were accompanied by an abnormal sensitivity to light and sound. Results from these questions can be found in Table VI. Question #10 asked all subjects if they “have had more than four attacks in their lifetime?” It was found that 31.51% (n = 133 of 427) of the subjects responding satisfied this criteria.

Table VI  Response to Survey Questions #9a and #9b

<table>
<thead>
<tr>
<th></th>
<th># of “Yes” answers</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches accompanied by abnormal sensitivity to light?</td>
<td>192 of 427</td>
<td>44.96%</td>
</tr>
<tr>
<td>Headaches accompanied by abnormal sensitivity to sound?</td>
<td>182 of 427</td>
<td>42.62%</td>
</tr>
</tbody>
</table>

After analyzing the surveys through the algorithm, it was found 2.91% (n = 23 of 791) of the total sample was classified as having IHS migraines (Table VII). Prevalence rates for all other headache categories can be found in Table VII.

Table VII  Prevalence

<table>
<thead>
<tr>
<th>Classification</th>
<th>Total Population (n = 791)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHS Migraine</td>
<td>23</td>
<td>2.91%</td>
</tr>
<tr>
<td>Borderline Migraine</td>
<td>30</td>
<td>3.79%</td>
</tr>
<tr>
<td>Possible Migraine</td>
<td>56</td>
<td>7.08%</td>
</tr>
<tr>
<td>Non-Migraine Headache</td>
<td>318</td>
<td>40.20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>427</strong></td>
<td><strong>53.98%</strong></td>
</tr>
</tbody>
</table>

Prevalence of Migraines Between Gender

It was reported for gender groups, that 0.90% (n = 3 of 332) of males and 4.36% (n = 20 of 459) of females in the total sample were classified as having an IHS
migraine (Table VIII). The rest of the prevalence figures for all of the different headache classifications can be found in Table VIII.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Total Population</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males (n = 332)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IHS Migraine</td>
<td>3 of 332</td>
<td>0.90%</td>
</tr>
<tr>
<td>Borderline Migraine</td>
<td>18 of 332</td>
<td>5.42%</td>
</tr>
<tr>
<td>Possible Migraine</td>
<td>10 of 332</td>
<td>3.01%</td>
</tr>
<tr>
<td>Non-Migraine Headache</td>
<td>115 of 332</td>
<td>34.64%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>146 of 332</td>
<td>43.98%</td>
</tr>
<tr>
<td><strong>Females (n = 459)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IHS Migraine</td>
<td>20 of 459</td>
<td>4.36%</td>
</tr>
<tr>
<td>Borderline Migraine</td>
<td>12 of 459</td>
<td>2.61%</td>
</tr>
<tr>
<td>Possible Migraine</td>
<td>46 of 459</td>
<td>10.02%</td>
</tr>
<tr>
<td>Non-Migraine Headache</td>
<td>203 of 459</td>
<td>44.23%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>281 of 459</td>
<td>61.22%</td>
</tr>
</tbody>
</table>

All questions were analyzed with chi square tests to determine if there were significant differences in how gender groups answered. It was found that females reported that they were subject to migraines more frequently than males ($X^2 = 23.061$, $p < 0.001$). It was also found that females reported having their migraines last longer than 72 hours more often than males ($X^2 = 10.845$, $p = 0.001$). In addition females ($X^2 = 4.602$, $p = 0.032$) reported having throbbing headaches more frequently than their male counterparts. Females reported headaches with a hypersensitivity to light ($X^2 = 5.213$, $p = 0.022$) and sound ($X^2 = 17.071$, $p < 0.001$) more often than males. Lastly, females ($X^2 = 13.149$, $p < 0.001$) were found to report having more than four headache attacks in their lifetime more frequently than males. Results from all chi square tests for survey questions by gender can be found in Table IX.
Chi square tests were also performed on the prevalence of all headache classifications between gender in the current study. It was found that females reported more IHS migraines ($X^2 = 8.140, p = 0.004$), possible migraines ($X^2 = 14.390, p < 0.05$), and non-migraine headaches ($X^2 = 7.367, p = 0.007$) than males. However, borderline migraines were reported more often in males than females ($X^2 = 4.161, p = 0.041$). Results from all chi square tests performed on the prevalence of headache disorders between gender can be found in Table X.

### Table IX Chi Square Tests for Survey Questions - Gender

<table>
<thead>
<tr>
<th>Question</th>
<th>$X^2$ for Gender</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have headaches?</td>
<td>23.061</td>
<td>0.001*</td>
</tr>
<tr>
<td>Do you have headaches every day?</td>
<td>10.845</td>
<td>0.001*</td>
</tr>
<tr>
<td>How long do your headaches last?</td>
<td>2.658</td>
<td>0.447</td>
</tr>
<tr>
<td>Location of headache</td>
<td>5.045</td>
<td>0.169</td>
</tr>
<tr>
<td>Throbbing headache?</td>
<td>4.602</td>
<td>0.023*</td>
</tr>
<tr>
<td>Headaches inhibit daily activity?</td>
<td>0.046</td>
<td>0.830</td>
</tr>
<tr>
<td>Headaches get worse with activity?</td>
<td>1.600</td>
<td>0.206</td>
</tr>
<tr>
<td>Nausea/vomiting?</td>
<td>0.652</td>
<td>0.419</td>
</tr>
<tr>
<td>Light sensitivity?</td>
<td>5.213</td>
<td>0.022*</td>
</tr>
<tr>
<td>Sound sensitivity?</td>
<td>17.071</td>
<td>0.001*</td>
</tr>
<tr>
<td>More than four lifetime episodes?</td>
<td>13.149</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

* = $p < 0.05$

### Table X Chi Square Tests for Prevalence - Gender

<table>
<thead>
<tr>
<th>Classification</th>
<th>$X^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHS Migraine</td>
<td>8.140</td>
<td>0.004*</td>
</tr>
<tr>
<td>Borderline Migraine</td>
<td>4.161</td>
<td>0.041*</td>
</tr>
<tr>
<td>Possible Migraine</td>
<td>14.390</td>
<td>0.001*</td>
</tr>
<tr>
<td>Non-Migraine Headache</td>
<td>7.367</td>
<td>0.007*</td>
</tr>
</tbody>
</table>

* = $p < 0.05$
Prevalence of Migraines Between Ethnic Groups

When comparing the prevalence rates for IHS migraine between ethnicity, it was found that Caucasians had a rate of 3.26% (n = 14 of 429) while African Americans had a rate of 3.14% (n = 9 of 287). Results from all prevalence rate calculations by ethnic group can be found in Table XI.

Table XI Prevalence by Ethnicity

<table>
<thead>
<tr>
<th>Classification</th>
<th>Total Population</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Caucasian (n = 429)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| IHS Migraine                    | 14 of 429        | 3.26%
| Borderline Migraine             | 13 of 429        | 3.03%
| Possible Migraine               | 26 of 429        | 6.06%
| Non-Migraine Headache           | 183 of 429       | 42.66%
| **Total**                       | 236 of 429       | 55.01%|
| **African American (n = 287)**  |                  |      |
| IHS Migraine                    | 9 of 287         | 3.14%
| Borderline Migraine             | 14 of 287        | 4.88%
| Possible Migraine               | 18 of 287        | 6.27%
| Non-Migraine Headache           | 105 of 287       | 36.59%
| **Total**                       | 146 of 287       | 50.87%|
| **Other (n = 75)**              |                  |      |
| Borderline Migraine             | 3 of 75          | 4.00%
| Possible Migraine               | 12 of 75         | 16.00%
| Non-Migraine Headache           | 30 of 75         | 40.00%
| **Total**                       | 45 of 75         | 60.00%|

Chi square tests were also performed on the responses all survey questions for ethnicity in the current study. It was found that African Americans reported more throbbing headaches than expected ($X^2 = 81.865$, p = 0.001). Also, it was found that African Americans reported that their headaches got worse during activity more frequently than other ethnic groups ($X^2 = 6.247$, p = 0.044). Lastly, it was found that “other” ethnic groups reported that they had expressed more than four lifetime attacks
more often than Caucasians and African Americans ($X^2 = 7.104$, $p = 0.029$). Results from all chi square tests performed on survey questions for ethnicity can be found in Table XII.

Table XII Chi Square Tests for Survey Questions - Ethnicity

<table>
<thead>
<tr>
<th>Question</th>
<th>$X^2$ for Ethnicity</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have headaches?</td>
<td>2.395</td>
<td>0.302</td>
</tr>
<tr>
<td>Do you have headaches every day?</td>
<td>0.305</td>
<td>0.858</td>
</tr>
<tr>
<td>How long do your headaches last?</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Location of headache</td>
<td>7.790</td>
<td>0.254</td>
</tr>
<tr>
<td>Throbbing headache?</td>
<td>81.865</td>
<td>0.001*</td>
</tr>
<tr>
<td>Headaches inhibit daily activity?</td>
<td>2.057</td>
<td>0.358</td>
</tr>
<tr>
<td>Headaches get worse with activity?</td>
<td>6.247</td>
<td>0.044*</td>
</tr>
<tr>
<td>Nausea/vomiting?</td>
<td>0.968</td>
<td>0.616</td>
</tr>
<tr>
<td>Light sensitivity?</td>
<td>0.100</td>
<td>0.951</td>
</tr>
<tr>
<td>Sound sensitivity?</td>
<td>0.145</td>
<td>0.930</td>
</tr>
<tr>
<td>More than four lifetime episodes?</td>
<td>7.104</td>
<td>0.029*</td>
</tr>
</tbody>
</table>

* = $p < 0.05$

When looking at the prevalence rates between ethnic groups, it was found that all other ethnic groups reported more possible migraines than Caucasians and African Americans ($X^2 = 10.034$, $p = 0.007$). Results from all chi-square tests calculated for prevalence between ethnic groups can be found in Table XIII.

Table XIII Chi Square Tests for Prevalence - Ethnicity

<table>
<thead>
<tr>
<th>Classification</th>
<th>$X^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHS Migraine</td>
<td>2.491</td>
<td>0.288</td>
</tr>
<tr>
<td>Borderline Migraine</td>
<td>1.619</td>
<td>0.445</td>
</tr>
<tr>
<td>Possible Migraine</td>
<td>10.034</td>
<td>0.007*</td>
</tr>
<tr>
<td>Non-Migraine Headache</td>
<td>2.639</td>
<td>0.267</td>
</tr>
</tbody>
</table>

* = $p < 0.05$
Chapter V
Discussion

Little investigation has been done on the topic of migraines in athletes. This study attempted to describe the prevalence of migraines within an athletic population. This chapter will focus on interpreting the results found in the current study and provide a basis of application. The purpose of this study was to describe the prevalence of migraines in a sample of NCAA Division I men and women’s basketball players.

Overall Prevalence of Migraines

Surveys from 791 male and female NCAA Division I basketball players from 51 different colleges/universities across the United States revealed that 2.91% of the total sample was diagnosed as having migraines according to IHS criteria. In contrast, using a similar questionnaire and the same algorithm, Henry et al. (1992) found that 8.1% of the French population over the age of 15 suffered from migraines. One key difference between the two studies was that Henry et al. conducted the study face-to-face, while the current study was conducted by a mailed survey. This could account for some of the difference between the two populations. More similarly, Stang et al. (1993) reported from data acquired from the National Health Interview Study conducted in 1989 that the prevalence of migraines was 4.1% among Americans. The main limitations to their study was that migraines were self-reported and not subject to any diagnostic criteria. Having specific criteria available to aid in the calculation of prevalence rates helps build an objective framework for a subjective set of symptoms.
Without a framework to work with when determining a prevalence rate, one would deduce that the rate calculated would be higher due to the inclusion of those who would grade out having either borderline migraines, possible migraines, or non-migraine headaches.

Stewart et al. (1992) found the prevalence of migraines in the United States to be 7.56%. The researchers utilized the IHS diagnostic criteria in a self-administered mailed questionnaire. One limitation to this study was that the head of the household was asked to identify those who suffered from “severe headaches.” After this was done, those subjects who were previously identified, filled out a survey pertaining to headaches. Since the questionnaire was self-administered, the interpretation of “severe headaches” was at the discretion of the person responding to the survey. This could account for some variation when compared to other studies.

Another limitation in Stewart et al. (1992) was that there was not anyone present when the survey was completed. Rasmussen, Jensen, & Olsen (1991) reported that there are several problems when using a self-administered questionnaire to diagnosis a migraine. Although a self-administered questionnaire is easy to send out and there is an increased assurance that each question will be presented in a uniform manner, the response rate is diminished when compared to an interview study (Rasmussen et al., 1991). In addition, Rasmussen et al. (1991) stated that the flexibility of a clinical interview can increase the validity of the testing, but caution must be taken that the interviewer does not subconsciously influence the subject.
Linet et al. (1989) found the prevalence of migraines in 18-23 year old subjects residing in Washington County, Maryland to be 5.30%. Diagnosis was determined by two separate phone interviews. The first one identified those households that might have a migraine sufferer residing in the house. The second phone interview asked those previously identified by the first interview, more specific questions about his/her headaches to see if the symptoms fit the migraine criteria. One main limitation of this study was that they did not use the IHS diagnostic criteria. Instead, they used a modified definition that included any subject who reported having nausea/vomiting that accompanied a headache with a visual prodrome, a unilateral headache with a visual prodrome, or nausea/vomiting that accompanied a unilateral headache without a visual prodrome. Even though Linet et al. (1989) felt comfortable using this definition for their study, it does not take into account the interaction of symptoms as does the IHS criteria.

With the exception of the study conducted by Stang et al. (1992), it was noted that the respondents of this study showed a decreased prevalence of migraines when compared to the general population of the United States. Interestingly, the prevalence rate of handlers, helpers, and laborers was similar with that of the athletes in this study (Stang et al., 1992). This type of occupation is known to be physically enduring in nature. Therefore, it is logical to expect this population to have a similar prevalence rate of migraines when compared to athletes. One reason for the consistency in prevalence may be due to the increased concentration of beta-endorphins, serotonin, beta-lipotropin, and adrenocorticotropic hormones within the body in athletes. It has
been reported that exercise or heavy physical activity increases beta-endorphins and other hormones that elevate the pain threshold (Neusub et al., 1997).

Another reason why athletes might see a decreased prevalence of migraines compared to the general population is due to natural selection. The current sample in this study, NCAA Division I men and women’s basketball players, is very competitive. It takes a great deal of skill and physical preparation to develop one’s body and mind to compete at this level. Neusub et al. (1997) reported that aerobic endurance was reduced in both male and female headache/migraine sufferers. In addition, it was found that female headache/migraine sufferers showed an increase in body fat and a decrease in flexibility when compared to healthy controls (Neusub et al., 1997). Wray et al. (1995) showed that migraine sufferers performed better than controls on low-level visual processing tasks. However, they performed significantly worse on high-level visual processing tasks when compared to healthy controls (Wray et al., 1995).

Hassinger et al. (1999) reported that after consecutive physical and cognitive stressors, migraine sufferers returned to a significantly higher state of total peripheral resistance (TPR), lower cardiac output (CO), and lower stroke volume (SV) than healthy controls. This showed that migraine sufferers experienced a lagging vasoconstriction during the recovery period after subsequent physical and cognitive task (Hassinger et al., 1999). Results of all prevalence studies reviewed for discussion are presented in Table XIV.
Table XIV  Meta-analysis of Prevalence Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>N-Size</th>
<th>Overall</th>
<th>Males</th>
<th>Females</th>
<th>Caucasians</th>
<th>African Americans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinart</td>
<td>2000</td>
<td>791</td>
<td>2.91%</td>
<td>0.90%</td>
<td>4.36%</td>
<td>3.26%</td>
<td>3.14%</td>
</tr>
<tr>
<td>Henry</td>
<td>1992</td>
<td>4,204</td>
<td>8.1%</td>
<td>4.00%</td>
<td>11.9%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stang</td>
<td>1993</td>
<td>116,929</td>
<td>4.1%</td>
<td>2.32%</td>
<td>5.77%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stewart</td>
<td>1992</td>
<td>20,468</td>
<td>7.56%</td>
<td>5.70%</td>
<td>17.6%</td>
<td>7.72%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Stewart</td>
<td>1996</td>
<td>12,328</td>
<td>-</td>
<td>8.20%</td>
<td>19.00%</td>
<td>20.40%</td>
<td>16.20%</td>
</tr>
<tr>
<td>Linet</td>
<td>1989</td>
<td>3210</td>
<td>5.30%</td>
<td>3.00%</td>
<td>7.4%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

When analyzing the results of the current study and the available literature, those suffering from migraines would have a disadvantage compared to non-migraine sufferers. Not having migraines would allow them to be unhindered in pursuit of crucial performance characteristics that would allow them the opportunity to compete at a higher level.

**Prevalence of Migraines Between Gender**

Results showed that 0.90% of males and 4.36% all females were classified as having migraines. Similar ratios between men and women were reported by Stang et al. (1993) showing that 2.32% of males and 5.77% of females reported having migraines. Consistent with what Stang et al. found, Linet et al. (1989) reported that 3.0% of males and 7.4% of females were subject to migraines. Limitations to these two studies were that Stang et al. had subjects self-report migraines without the use of diagnostic criteria, while Linet et al., did not use IHS diagnostic criteria to determine the diagnosis of a migraine within their study.
Henry et al. (1992) reported that 4.0% of males and 11.9% of females in France were subject to migraines determined by a face-to-face interview. These results showed an higher incidence of migraines than in the current study. Henry’s study was similar to the present one in that they used the same algorithm and a similar questionnaire to determine their prevalence. Reporting higher prevalence rates, Stewart et al., (1992) found through a mailed survey that the prevalence of migraines was 5.7% in males and 17.6% in females residing in the United States.

The difference in prevalence of migraines between males and females in the current study was significantly different ($X^2 = 8.140, p = 0.004$). Chi square tests were also performed on the prevalence all headache classifications between gender. It was found that females reported more possible migraines ($X^2 = 14.390, p = 0.001$), and non-migraine headaches ($X^2 = 7.367, p = 0.007$) than males. However, borderline migraines were reported more often in males than females ($X^2 = 4.161, p = 0.041$).

It is clear through the results of this study and the review of others that there is a significant difference in the prevalence of migraines between males and females. One reason may be the menstrual cycle. It has been reported that estrogens and progestins might play a part in the increased prevalence of migraines in females (Silberstein et al., 1991). It is still unclear whether increased or decreased levels of estrogens and progestins are the cause of the disparity in prevalence rates between males and females. However, estrogen and progestins have been found to have significant effects in modulating neural activity and receptor density, which can impact the ability to sustain a migraine (Silberstein et al., 1991).
Celentano, Linet, & Stewart (1990) have proposed another reason for the difference in prevalence rates. Their theory centers on the fact that females may experience migraines much differently than males. Part of this theory resides in the fact that they found differences in the perception of symptoms that go along with their migraines (Celentano et al., 1990). Males, more often than females, reported to interpret their headaches as "just part of normal life" (Celentano et al., 1990). Females may also be more attentive to the symptoms of their migraines than males (Celentano et al., 1990). In addition, females were twice as likely to seek the care of a physician for their headaches as opposed to males (Celentano et al., 1990). This all points to a possible "social model" to explain the difference between males and females in the prevalence in migraines.

Prevalence of Migraines Between Ethnic Groups

Results of this study showed that 3.26% of Caucasians and 3.14% of African Americans were classified as having migraines. Somewhat higher and with a disparity, Stewart et al., (1992) found that 7.72% of Caucasians and 5.9% of African Americans suffered migraines. In an additional study, Stewart et al., (1996) found that Caucasian males and females had a migraine prevalence of 8.6% and 20.4%, while African American males and females had rates of 7.2% and 16.2% respectively.

When looking at the prevalence rates between ethnic groups, it was found that all other ethnic groups reported more possible migraines than Caucasians and African Americans ($X^2 = 10.034, p = 0.007$). The prevalence rate for IHS migraines between ethnic groups was not significantly different. This is a departure from what the
literature reports. One reason for this might be that the current studies population is very specific and narrow. All of the studies in the literature report prevalence across age and socioeconomic classes. In addition, the current study had a smaller N-size compared to the literature reviewed.

The increased prevalence of migraines in Caucasians compared to African Americans within the literature, has been proposed to be due to inherited factors related to their susceptibility to attacks (Stewart et al., 1996). Variations in neurotransmitter metabolism and receptor availability/density can influence the internal biologic environment to trigger an attack (Stewart et al., 1996). In addition, phenotypic differences in catabolic enzymes that metabolize triggers in common foods, like cheese and wine, have been found to differ between Caucasians and African Americans (Stewart et al., 1996).

Other Findings

Although not a primary purpose of the study, the following observations were noted during data collection and analysis. Results showed that 7.96% (n = 34 of 427) of those subjects reporting that they were subject to headaches (question #2) had them occur every day. This was interesting to note because, even though these subjects were not diagnosed with migraines, this represents a large number of athletes with this type of symptom. Regardless of being diagnosed with migraines due to having daily headaches (IHS, 1988), this presents sports medicine professionals with the problem of athletes with pain and disability similar to that of migraine sufferers. This can’t be ignored or downplayed just because the athlete has not been diagnosed as a migraine
sufferer. A large number of the deficits in physical and mental abilities found in migraine sufferers, are similar in chronic headache patients.

This study also showed that 42.62% of those complaining of headaches recorded that they became worse with physical activity (question #7). In addition, 44.96% and 42.62% of those subject to headaches reported an abnormal sensitivity to light and sound (questions #9a & #9b). These are significant findings in that almost half of the sample complaining of headaches had a symptom that could significantly impact their performance. If these complaints are not taken seriously, these non-migraine-suffering athletes might be at a disadvantage comparable to that of a migraine sufferer.

Lastly, it was found that only 31.15% of those subject to headaches reported that they had more than four lifetime attacks (question #10). This finding is interesting in that it shows a limitation to the findings above. Only about one-third of those suffering from headaches (question #1) had experienced more than four lifetime attacks. That leaves about two-thirds of the sample that had experienced less than four episodes over their lifetime. Therefore, even though almost half of the headache-experiencing population had their episodes get worse with physical activity or experience phono/photophobia, a large majority of them had less than four headaches/migraines over their lifetime and they were excluded from the criteria of IHS migraines.
Limitations

Several limitations occurred in this study. First of all, only NCAA Division I athletes were used. Because this level of basketball is very competitive, it would be logical to assume that if an athlete were predisposed to a problem like migraines on frequent basis, he/she would not make it to this level. Being hindered by pain and vision/motor control issues would make it difficult for very exceptional performers due to a lack of consistency in performance. Therefore, the results must only be applied to other Division I athletes to make a valid comparison.

Secondly, it was noted that several schools only had those who were subject to migraines/headaches complete the questionnaire, instead of everyone on the current roster. Although the numbers of these occurrences were small, the prevalence might have been over-reported due to the exclusion of healthy subjects.

Another limitation was that Caucasians (n = 429 of 791) and African Americans (n = 287 of 791) made up 90.5% of the total sample size. All other ethnic groups combined (n = 75 of 791) comprised only 9.5% of the sample. Therefore, the comparisons made with all other ethnic groups combined might not be valid.

A potential limitation of the current study may have been that a paper survey was used to collect information about headache features. No person-to-person contact was made between the researcher and the subjects. Although the survey was validated (Henry et al., 1992), there was not anyone present to answer questions when the survey was completed. This allows for different interpretation and perception to the survey questions. Differences, in interpretation of what constitutes an abnormal sensitivity to
light/sound or what a throbbing headache is what might make subjects have a false positive or false-negative to a specific diagnosis.

Also, the time in which the surveys were sent out might have been an additional limiting factor towards the return rate. Although there were 791 of 6000 (13.18%) surveys correctly completed from 51 of 200 (25.5%) schools, the number might have been higher if the survey were not sent out at the time of conference and NCAA tournaments.

Lastly, the N-size of the current study and those of the studies used for comparison within the literature were vastly different. The current study had an N-size of 791 subjects. The studies used for comparison had N-sizes ranging from 2,479 to 116,929 subjects. Due to the large difference in sample sizes, this must be taken in consideration.

Suggestions for Future Research

Based on the results of this study, it is recommended that further research be conducted in the area of migraines in athletes and athletic performance. One suggestion would be to add to the current study by increasing the N size, including other sports, and adding NCAA Division II/III, NAIA, and junior colleges into the sample. This would give us a better overall picture of the prevalence of migraines within competitive athletes. In addition, a study could be conducted that uses the same survey and algorithm with college athletes and the general college population.
Conclusion

In conclusion, it was found that, 1). the prevalence of migraines in NCAA Division I men and women’s basketball players was generally less than what was seen for the general population, and 2). Females showed an increased prevalence of migraines when compared to males. Also, Caucasians and African Americans did not differ in prevalence of migraines. In addition, it is also recommended that certified athletic trainers, physicians, coaches, and athletes be aware of migraines/headaches as having the ability to cause significant disability and hinder performance.
References


Appendix A
Letter to Head Athletic Trainer

January 5, 2000

Dear Head Athletic Trainer:

My name is Chad Kinart. I am a graduate student at the University of Nebraska at Omaha working on my graduate thesis entitled, “Prevalence of Migraines in NCAA Division I Men and Women’s Basketball Players.” The purpose of this study is to identify the prevalence of migraines in athletes.

Enclosed is a survey that I would like you to administer to your men and women’s basketball teams. A good time to administer the survey would be the beginning of practice while the team is stretching or while on the bus/plane during a road trip. The survey consists of basic demographic questions followed by 10 specific questions pertaining to headaches. It should only take about 5-10 minutes to complete. When the athletes are finished filling out the surveys, please collect them and mail them in the self-addressed and stamped envelope that is provided by February 16, 2000.

Thank you very much for your cooperation with my study. I hope that the results of the study will be beneficial to you and your athletes. If requested, I will be sending out a summary of the results when I am completed. If you have any questions, feel free to call me. Again, thank you for your help.

Sincerely,

Chad Kinart, ATC
University of Nebraska at Omaha
6001 Dodge FH024
Omaha, NE 68182
(w) 402-554-4997
(h) 402-392-7395
Appendix B

Survey Instrument

This survey is going to ask you questions about features and characteristics of headaches. Please answer all of the following questions to the best of your knowledge. Please note that you are under no obligation to complete this survey. If you choose to go forward, you are implying your consent for the following information to be used in this study. Your name and any other identifiers will not be attached to any of your answers, and therefore all information collected from the surveys will be confidential.

Gender - Male Female

Race - Caucasian Asian African-American Mexican-American Native-American Multi-Racial Other

Answer all questions to the best of your ability. Thank you for your cooperation!
Circle the answer that applies to you the most.

Age - 

1. Are you subject to headaches? Yes No (if no, don’t complete the survey)
2. Do you suffer from headaches every day? Yes No Do not know
3. How long do your headaches last without medication?
   Less than Four hrs Four – 72 hrs Greater than 72 hrs Do not know
4. What is the usual location of your headache? Strictly one side of the head
   Alternately in right and left part of the head Other location Do not know
5. Throbbing type of headache? Yes No Do not know
6. Do your headaches inhibit or prevent daily activities? Yes No
7. Do your headaches get worse during physical activity? Yes No
8. Are your headaches accompanied by nausea and/or vomiting? Yes No
9a. Are your headaches accompanied by abnormal sensitivity to light? Yes No
9b. Are your headaches accompanied by abnormal sensitivity to sound? Yes No
10. Have you had more than 4 attacks in you lifetime? Yes No
Appendix C

Original Survey

1. Are you subject to headache?  Yes  No
2. Do you suffer from headache every day?  Yes  No  Do not know
3. How long are your headaches usually, without medication?  < 4 hrs  4-72 hrs  more than 72 hrs  Do not know
4. What is the usual location of your headaches?  Strictly unilateral  Other location
   Alternately in the right and left part of the head  Do not know
5. Pulsating type of headaches?  Yes  No  Do not know
6. Do your headaches inhibit or prevent daily activities?  Yes  No  Do not know
7. Do your headaches get worse during physical activity?  Yes  No  Do not know
8. Are your headaches accompanied by nausea or vomiting?  Yes  No  Do not know
9a. Are your headaches accompanied by photophobia?  Yes  No  Do not know
9b. Are your headaches accompanied by phonophobia?  Yes  No  Do not know
10. Have you had more than 4 attacks in your lifetime?  Yes  No  Do not know
Appendix D
Diagnostic Algorithm

Non-migraine Headache

Possible migraine

Non-migraine Headache

Possible migraine

Non-migraine Headache

"Borderline" migraine

IHS migraine

Means that two positive answers from questions 5, 6, 7 and 8 are required.

Represented by 1* in the text

yes = Positive answer
no = Negative answer