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Title: The Relationship between Biorhythms and Injuries to College Football Participants

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Richard F. Irvin

Purpose: The general problem was to determine the relationship between biorhythms and injuries to college football participants representing Oregon State University.

Procedures: The population consisted of one hundred and ninty two football players representing Oregon State University who participated in the intercollegiate football seasons of 1981 and 1982. Injury data and birth data for this study were obtained from Kevin O'Neill Oregon State University Head Athletic Trainer. The injury data were recorded for each year and added for total number of injuries. The method referred to as "biomathematics" as outlined by Thommen was selected as the most appropriate procedure to calculate and chart the biorhythms of the injuried football players.

To examine the accuracy of Thommen's charting method, the Dialgraf calculator was also used.

Analysis of Data: The data were analyzed by means of chi square design. A significant level of .05 for rejection or

acceptance of the null hypothesis was selected:

Conclusions: From the statistical evaluation of the results, the following conclusions may be made.

1. There is no relationship between the critical days of the biorhythm of individual players and the occurrence of football injuries.
2. There is no relationship between the physical, the emotional and the intellectual biological rhythms and the occurrence of football injuries.
3. There is no relationship between the combination of physical, emotional and intellectual biological rhythms and the occurrence of football injuries.

THE RELATIONSHIP BETWEEN BIORHYTHMS AND INJURIES TO COLLEGE FOOTBALL PARTICIPANTS

by

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Expecially, I would like to dedicate this thesis to my wife, Seong Ok Jun, for her never-ending deep love and encouragement and to my sweet daughter, Jin Sun, and my second baby of this March.

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CHAPTER I

INTRODUCTION

Everyone experiences days when everything seems to go right; on the other hand, there are also those days when nothing goes right.

At the beginning of this century researchers began to probe further into the question of why man's disposition differs from day-to-day. According to Luce (23), even Hippocrates advised his students and associates some 2400 years ago to observe the "good and bad" days among the healthy and the ill and to take these fluctuations into consideration when treating the patient (11, 35, 23). The biorhythm theory has been applied in many different fields. Numerous physicians in Europe who strongly believe in the biorhythm theory will not perform surgery when their patients are experiencing a critical day. In the fields of medicine, industrial safety, and psychology, biorhythm cycles are being investigated and are considered by many to be pertinent to performance, safety and well being of people in many nations.

Thommen (35) has cited the results of research involving athletic contests in various sports and games of mental concentration in which a significant correlation between human performance and biorhythms has been indicated. Based upon current findings of general biological rhythm research, there is no relationship between biorhythm cycles and human performance. Athletes, coaches, and interested spectators have often questioned why highly conditioned and trained athletes exhibit a high performance one period and a substandard performance the next under virtually identical conditions. This study is a consideration of the relationships between biorhythm and athletic injuries.

Statement of the Problem

The general problem was to determine the relationship between biorhythms and injuries to college football participants representing Oregon State University.

The sub-problems were to:

1. Determine the critical days, the physical, emotional and intellectual biorhythm cycles of the individuals selected for this study.
2. Determine the extent of the relationships by comparing the biological rhythms with football injuries.
3. Determine the incidence of football injuries by anatomical location.

Delimitations

This study was delimited to the following:

1. One hundred and ninty-two football players representing Oregon State University who participated in the intercollegiate football seasons of 1981 and 1982.
2. The 23-day physical cycle, the 28-day emotional cycle,

the 33-day intellectual cycles, and critical days within each individual's biorhythm pattern.

Limitations

This study was limited by:

1. Exogenous and endogenous factors upon the subjects performance.
2. The unavailability of data concerning the exact time of birth of the selected participants.
3. Obtaining the data pertaining to injuries, and determining a method for charting the selected biological rhythms.

Hypotheses

The following hypotheses were stated in the null form and analyzed at the 0.05 level of significance:

1. There will be no significant relationship between the critical days of the biorhythm of individual players and the occurrence of football injuries.
2. There will be no significant relationship between the physical biological rhythm of individual players and the occurrence of football injuries.
3. There will be no significant relationship between the emotional biological rhythm of individual players and the occurrence of football injuries.
4. There will be no significant relationship between the

intellectual biological rhythm of individual football players and the occurrence of football injuries.

5. There will be no significant relationship between the combination of physical and emotional biological rhythms and the occurrence of football injuries.

6. There will be no significant relationship between the combination of emotional and intellectual biological rhythms and the occurrence of football injuries.

7. There will be no significant relationship between the combination of intellectual and physical biological rhythms and the occurrence of football injuries.

8. There will be no significant relationship between the combination of physical, emotional and intellectual biological rhythms and the occurrence of football injuries.

Assumptions

The following assumptions were identified as being relevant to this study:

1. Athletic trainers recorded the data fully and precisely.
2. Football player's birthdate is accuate.
3. The injury date is correct.
4. The method of charting the selected biological rhythms would be an effective tool and could be statistically analyzed.
5. The data needed and collected for each injured player would provide information necessary to compare injuries

with the biological rhythms.

6. Each individual participated to his maximum ability during practice or game.

Definition of Terms

For this study, terms were divided into the two categories of conceptual and functional. Conceptual definitions include those terms which have been defined by authorities. Functional definitions consisted of those terms which held special meaning for this study.

Conceptual Definitions

The following conceptual definitions were emphasized in order to delineate certain aspects of this study:

Biological rhythms. The oscillation of rhythmical changes in the human body which pertain to recharge or discharge within the cellular system (Thommen, 1973).

Biorhythms. The consistent recurrence of physical, emotional, and intellectual cycles (Thommen, 1973).

1. Emotional biorhythm: The 28-day rhythm that governs the nervous system. It affects the moods, sensitivity, and creativity of man (Thommen, 1973).
2. Intellectual biorhythm: The 33-day rhythm which pertains to traits generally associated with reasoning power, mental responsiveness, understanding, and concentration (Thommen, 1973).
3. Physical biorhythm: The 23-day rhythm that affects man's

physical strength, endurance, energy, resistance and physical confidence (Thommen, 1973).

Cycles The critical period, the minus period, and the plus period.

1. Critical period: The switch point days; the first day of a new cycle and when a rhythm changes from its high or discharge phase into the recuperative phase (Thommen, 1973).

2. Minus period: The recharging or recuperative period (Thommen, 1973).

3. Plus period: The ascending or discharge period (Thommen, 1973).

Endogenous. Independent of rhythmic external stimuli; originating from within the organism (Still, 1972).

Exogenous. Dependent upon rhythmic external stimuli; originating from outside the organism (Still, 1972).

Functional Definition

The functional definition included the following term:

Football injury. An injury occurring during a practice or game that prevented the player from participating for a minimum of one day.

Justification for the Study

The number of individuals participating in all types of athletic events at all age is increasing yearly. If there is value in participation in athletic activity, then the apparent trend towards increased participation in athletics would seem to be desirable.

However, in evaluating the total worth of athletics, the possible negative as well as positive effects need to be considered, and the risk of injury is certainly a negative factor. American tackle football is the nation's, if not the world's, most injurious sport. There is no team sport anywhere in the world in which injury occurs more frequently than in American football (34, 6, 5).

This study could be extremely valuable to football coaches and possibly to coaches of all athletics if a significant relationship is found between biological rhythms and football injuries. If this relationship exists, many football injuries could be predicted and perhaps prevented.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Our world has hundreds of cycles and rhythms that regularly repeat themselves. The earth rotating around the sun initiates the annual cycle of the seasons and is reflected in the blossoming time, growth rate, and other aspects of all green plants. Every 12½ hours, tides ebb and flow. Most women experience a menstrual cycle every 28 days. The moon reappears every 25 hours. Grasshopper plagues come 9.2 years apart. Rhythms, cycles continually affect life on earth (11). Scientists, thinkers, and physicians have always been concerned with cycles, with rhythms, as clues to the nature of man's life on earth.

In virtually every sport, in all aspects of athletic endeavor, the valleys and peaks of performers stand out clearly. The money, the glamor, the romance, the competitiveness of athletics have made what happens in the fantasy world of sports of interest to most of us in the real world. A great deal of interest also exists concerning the interrelationship of sports and biorhythms. One of the main areas of study and developing concern is why some performers on any given day or days are more inspired, less inspired, more effective, less effective. This concern has gone beyond the mystique of such terms as momentum, hot hands, slumps, etc., and has sought to explain the cycles, the rhythms of performance. Another area of study has centered on forecasting and projecting trends, patterns, results. But, there is a great amount of controversy over the reliability of the biorhythm theory.

The major concern of this study is to determine the relationship between biorhythms and injuries. Therefore, the literature reviewed was limited to those rhythms which related particularly to man.

To facilitate the review of these issues, this chapter was organized into the following topic areas:

1. Basics of biorhythms
2. Biological rhythms
3. Exogenous and Endogenous rhythms
4. Circadian rhythms in man
5. Biorhythm and athletic performance
6. The controversy over biorhythms

Basics of Biorhythms

The charting of the three biorhythm cycles in man is modeled after mathematical sinusoidal functions. Why should the sinusoid be selected as the model for these biological cycles? Indeed, nature in general seems to have a decidedly sinusoidal character; the motion of a pendulum, the bouncing of a ball, the vibration of a violin string, the political atmosphere in any country, and the economy, will almost display a reasonably sinusoidal character, as do the biorhythm cycles in man (2).

The basic rhythm, A, may be denoted by a sine wave with period T:

$$A = \sin\left[\frac{2\pi}{T}(t + \phi)\right] \qquad (2\text{-}1)$$

where: $2\pi = 360°$
T = period in days
t = time in cycle days
ϕ = phase displacement

Figure 1 illustrates a typical biorhythm cycle at a specified point in time.

At the moment of birth each of the three biorhythm cycles is initiated, and the cycles proceed to follow a fixed sinusoidal pattern throughout the life of an individual. The physical cycle, P, has a period of 23 days, the emotional (or sensitivity) cycle, S, a period

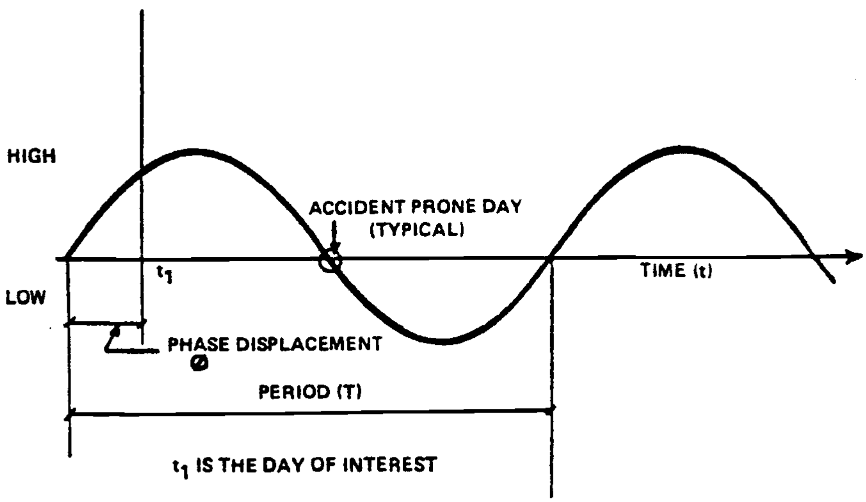


Figure 1 Typical Biorhythm Cycle

of 28 days, and the intellectual cycle, I, a period of 33 days. Individuals with different birth dates will consequently have different composite biorhythm charts, although the theory holds that the cycles of all individuals follow the same 23, 28 and 33 day biological rhythm (11, 35, 2). The three biorhythm cycles may be described at any point in time by the following relationship:

$$P = \sin\left[\frac{2\pi}{23}(t + \phi_1)\right] \qquad (2\text{-}2)$$

$$S = \sin\left[\frac{2\pi}{28}(t + \phi_2)\right] \qquad (2\text{-}3)$$

$$I = \sin\left[\frac{2\pi}{33}(t + \phi_3)\right] \qquad (2\text{-}4)$$

where: P = the physical cycle
ϕ_1 = physical phase displacement
S = the sensitivity cycle
ϕ_2 = sensitivity phase displacement
I = the intellectual cycle
ϕ_3 = intellectual phase displacement

The calculation of an individual's biorhythm at any given time requires first that the date being investigated be specified. The subject's age in days from the date of interest must next be determined. In the calculation, consideration should be given to regular leap years and centurial leap years. The phase displacement may then be calculated and employed in Equations (2-2), (2-3), and (2-4):

$$\phi = \left(\frac{Y}{CL} - CC\right) \qquad (2\text{-}5)$$

where: ϕ = phase displacement, or day of the current biorhythm cycle on which the observed event occurred
Y = subject's age
CL = cycle length in days (23 for physical, 28 for sensitivity, 33 for intellectual)
CC = whole number of completed cycles (whole number associated with Y/CL)

Figure 2 illustrates the three biorhythm cycles.

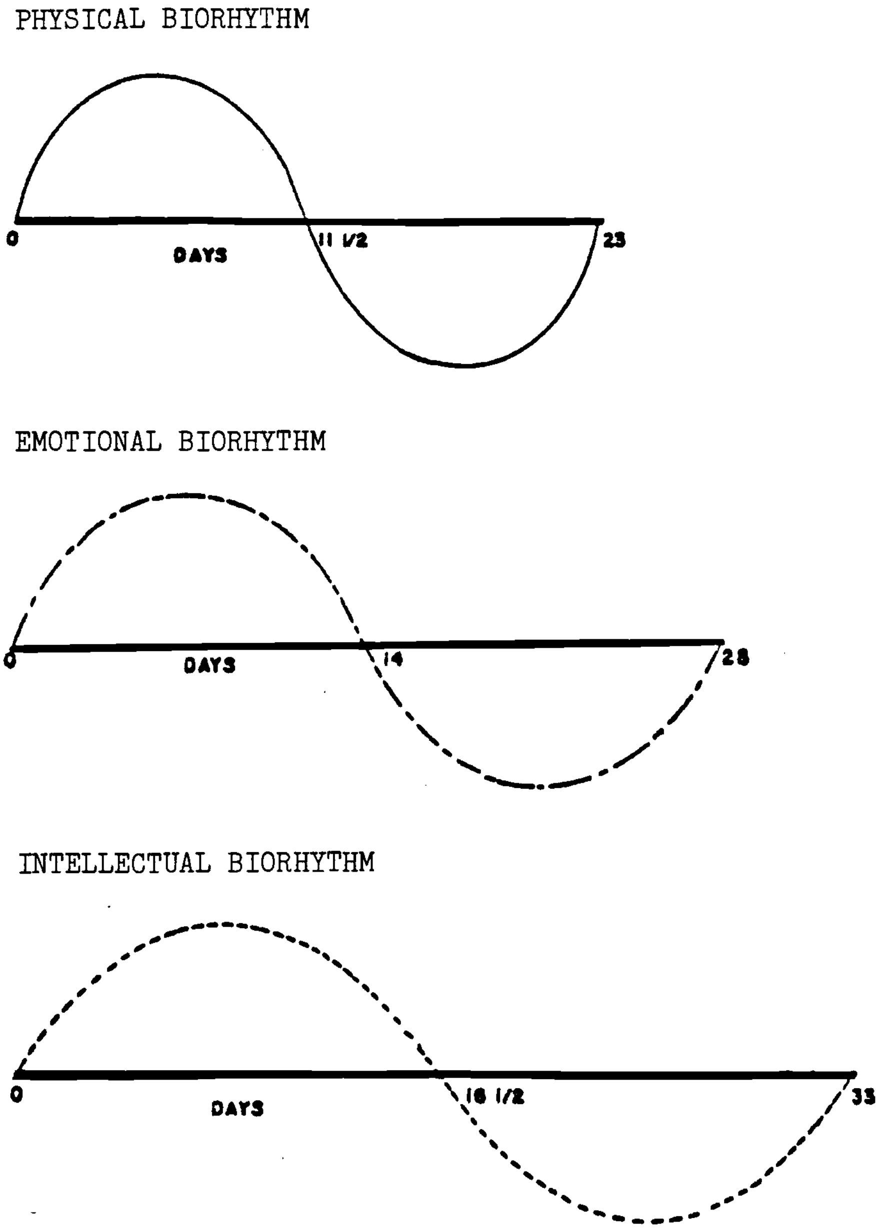


Figure 2 Three Biorhythm Cycles

Biological Rhythms

The word "biorhythm" is derived from the Greek words, bios, meaning life, and rhythmos, meaning a regulated beat. The biorhythm theory states that at the moment of birth, three cycles are initiated and recur consistently throughout a person's life. The three cycles have independent durations and influence the physical, emotional and intellectual states of the individual. Specific points in the cycle correspond to highs and lows in human performance (11, 35, 2).

The study of biorhythms dates back to the turn of the century. In order to place biorhythm study in its proper perspective, a brief history of its development is appropriate.

Dr. Herman Swoboda (1873-1963), a professor of psychology at the University of Vienna, did his initial research into the basic rhythms of man during the period of 1897 to 1902. Dr. Swoboda's research included the study of the birth of infants among his patients and the documentation of hundreds of family trees. From this analysis, he developed a mathematical analysis of the 23 day physical cycle and 28 day emotional cycle in man. Swoboda summarized the results of his research by stating that man's actions are influenced by periodic changes and that his reactions may be predicted. Dr. Swoboda showed that the psychologist can scientifically predict the periodic changes in man by use of a mathematical model. Swoboda also designed a slide rule whereby the "critical" days in a person's life could be computed based on the date of birth.

Dr. Wilheim Fliess (1859-1928), a practicing physician in Berlin, published the findings of his research on fundamental rhythms in man during the period of 1895 to 1905. Fliess's initial research dealt with a child's early immunity to a contageous disease subsequent to exposure to the disease. He traced the illness, the outbreak of the fever and deaths, and correlated them to the date of birth. Fliess' analysis included complicated mathematical calculations and statistics which tended to confuse the medical profession. Dr. Fliess concluded, however, that the 23 day rhythm was related to the human physical condition, while the 28 day cycle was related to the nervous system and influenced a person's emotional well-being and his degree of sensitivity (11, 35, 2).

Swoboda and Fliess developed their similar theories concerning the 23 and 28 day rhythms in man independently. Both researchers studied family trees and applied their knowledge of mathematics, psychology, and medicine to reach the conclusion that there is a biological clock in man.

Alfred Teltscher, a doctor of engineering and a teacher at Innsbrudk, performed important research during the 1920's into the cyclic characteristics of the mind (29). He found that his students' performance fluctuated in definite 33 day cycles. Teltscher believed that there were certain periods when a student could readily learn new subjects and other periods when the capacity to learn diminished. This periodicity was believed to have been caused by periodic, rhythmic secretions of glands affecting brain cells.

The existence of a mental cycle was also theorized by researchers in the United States during this same period. Dr. Rexford Hersey at the University of Pennsylvania, assisted by Dr. Michael Bennett, determined the presence of a 33 to 36 day rhythm related to mental function (29).

Another researcher whose work contributed to the acceptance of biorhythm science was Hans R. Frueh. Frueh's work encouraged medical doctors in Switzerland and Germany to use biorhythm calculations for surgery patients. Also at this time, safety engineers in the transportation industry began to use biorhythms for accident prevention (2).

Exogenous and Endogenous Rhythms

All living organisms are set into the framework of the physical world which pulses with an abundance of external rhythms: diurnal, tidal, seasonal, solar. It can thus be reasonably assumed that our bodies include components which are capable of rhythmic function.

Renbourn (30) conducted an extensive study of variations in a number of blood constituents, using healthy army personnel as subjects. Most individuals demonstrated regular diurnal curves for hemoglobin, hematocrit and plasma protein. The plasma protein level revealed no significant changes during the usual waking hours, but after 10 p.m. dropped markedly and independently of bed rest.

Hitchings and Fitz (21) determined a seasonal variation in the rate of human growth. The researchers weighed 20 boys once a week and measured their height every three months. Over 90 percent of the total increase in weight for the year occurred from June to December.

Biological rhythms in the true sense of the word are only those oscillations which can be shown to continue in the absence of periodic changes in the environment (36). Such rhythms are referred to as "endogenous" since they apparently arise from inside the organism. They are self sustaining oscillations capable of deriving the energy necessary for their maintenance from constant sources of energy (28).

Theoretically, the endogenous rhythms should appear if the organism is perfectly isolated from all external influences. This may, however, be difficult to achieve. Instead, we try to control as many environmental factors as possible.

The endogenous rhythms are caused by biological oscillators. They run with frequencies from 1000c/sec to durations of one day, month, year of more. There are: rhythmic nervous activity (nerve impulses, tremor; tapping, chewing, walking and breathing rhythms); other rhythmic muscular contractions (heart rate, pulse waves, blood pressure variations; mental activity rhythms (reaction times, interpretation of ambiguous optic illusions, judgement of time durations and creativity); variations in depth of sleep or frequency of dreaming; cyclic water and ion exchange over cell membranes or electric biopotential fluctuation; rhythmic glandular secretion; sexual cycles.

Circadian Rhythms

Biological and psychic variations that coincide closely with the alteration of day and night are termed 'diurnal' or 'circadian'. More definitively, any cycle that repeats itself every 21-28 hours is circadian. The time required for a single cycle is a 'period'. The reciprocal of period is its 'frequency'. As an example, the day and night cycle is completed every 24 hours (32).

Though extensive literature concerning cycles in plants, animals and insects exists, until recently human rhythmicity has not been intensively investigated. Aschoff (3) described more than 100 activities in humans which oscillate between maximum and minimum values diurnally. He noted variations in sleep and wakefulness, mental alertness, visceral and glandular activity, pulse and body temperature. In addition, 28-day and 30-day, seasonal and even yearly rhythms have been reported (24).

Two categories of biological periodicity are recognized. The 'exogenous' cycle is entirely dependent on an external oscillations, such as day and night. If environmental conditions are kept constant, the exogenous rhythm fades, or becomes desynchronized (32). According to Sollenberger (32), an 'endogenous' rhythm has its own natural period, varying with the organism. The environment may influence the phase frequency of an endogenous rhythm, but periodicity will persist even in the absence of all external cues.

It is possible that the sleeping-waking rhythm results from temporal relations between several component circadian rhythms: rhythm of activity of nervous structures, metabolic rhythms, etc.

The circadian rhythm of a subject can adapt itself to a change in local time. For instance, a subject can be conditioned to sleep during the day and be awake at night. A change in alterations of light and darkness can in fact modify the circadian rhythm of activity, provided that the way of life corresponds to the alternations. Many of man's physiological functions are known to exhibit a pronounced circadian rhythm. Gross motor activity is probably the function most often measured in studies of circadian rhythms. The best known and most readily measurable indicator of the physiological clock is the body temperature, with a high around 5:00 p.m. and a low between 4:00 and 5:00 a.m. Man's daily pattern of urination is also a tangible circadian rhythm. Urine is not exuded at a constant rate, but in a circadian rhythm, more in the morning and midday than at night. The contents of the urine obtained at varying hours during the day indicated that the kidney itself functions differently at different hours, thus indicating a circadian rhythm (23). Circadian rhythm in other bodily functions have been recorded in man: levels of blood sugar, metabolism, glucose utilization or energy release; food utilization; taste, smell, and hearing; reaction to drugs and stress, are a few of the circadian rhythms that may influence the way man feels and behaves. Muscular coordination, strength and time judgments vary in the course of 24 hours.

Biorhythm and Athletic Performance

Biorhythms have been invoked to explain either good or bad performance in individual sports such as golf, track and field, and motor racing (11, 35, 7, 38), wins and losses in dual sport such as tennis and boxing (19, 26), and even team performances in soccer and American football (11, 31).

The much publicized tennis match between Billie Jean King and Bobby Riggs in September, 1973, has been described by tennis authorities as an example of tactics winning over strength. Mrs. King was in a high intellectual phase and Riggs was in a negative stage intellectually (20).

Arnold Palmer, a well known professional golfer, established all kinds of records while winning the British Open in July, 1962. His biorhythm chart indicated a long, triple high, a condition that exists about every five months. Two weeks later he came in seventeenth in the Professional Golf Association tournament, one which everyone expected him to win. During this tournament all three of Palmer's biorhythms were in low or recuperative period (35).

The biorhythms of Rod Milburn, a world class high hurdler, were charted by Webos (37). The day Milburn set a world record his physical and emotional cycles were peaking. During Olympic trials his emotional cycles were near absolute lows and he barely ran 13.6 seconds on the same track where he previously had run 13.0 seconds. His cycles were high again at the Olympic games where he easily won and tied the world record.

Football teams and individual players have been a source for biorhythmic analysis. Willis and Case (11) charted the rhythms of players on the Missouri Southern State football team and made predictions of each individual's performance for each game. The week following the games the coach would give his evaluation of each player's performance to Case. She reported the biorhythm method was accurate on 77 percent of the cases. Case also indicated that of the 13 injuries during the season, 69 percent occurred on critical days.

Johnson (15) attempted to determine a relationship between biorhythm cycles and football injuries. He concluded from his findings that there was no relationship between the emotional and intellectual rhythms and the occurrence of football injuries but a possible relationship appeared between the physical rhythm and incidence of injury.

During the Olympic games of 1972, swimmer Mark Spitz became the first person to win seven gold medals. Spitz's biorhythm chart indicated he was in a physical and emotional high during all 10 days of the Games (11).

Martin (27) related biorhythms to competitive swimming performance. No significant difference was reported between the three rhythm cycle positions and official performances but a relationship was indicated between performance and biorhythms when the physical and emotional cycles were in oscillation synchronization.

Boxing competition has revealed some dramatic examples of the role of biorhythms in athletics. In 1959 Ingemar Johansson defeated Floyd Patterson for the World Heavyweight Championship. Most sportswriters predicted Johansson to win again during the rematch in 1960. Johansson's physical and emotional rhythms were negative while Patterson's were all positive for the fight. Patterson won the title (11).

When Muhammed Ali was soundly defeated by Ken Norton in 1973, Ali was undergoing a critical day in both his physical and emotional rhythms. In 1974 Ali defeated George Foreman. Ali was high in both emotional and physical rhythms, while Foreman was physically and emotionally low and one day away from an emotional critical phase (11).

Jack Gunthard, Swiss National Coach for Gymnastics, was reported by Gittelson (11) to regularly use biorhythms to predict the performance of athletes. He used the same method of prediction for over two years which proved 92 percent accurate. It was interesting to note Gunthard classified his gymnasts as 'rhythmist' or 'non rhythmists' which was determined by the predictions being almost always, mostly, or rarely true.

Helmut Benthaus, coach of a Professional Swiss soccer team, also made biorhythmic predictions for his players, according to Gittelson (11). Benthaus used the charts as a guide in training. When a player was on a physical high, the player was prescribed hard training but such exercise was forbidden when the player's physical rhythm was in a negative phase. However, several major studies, reported recently in scientific literature, conclude that birth-date "biorhythms" do not correlate with actual performance or events (4, 8, 10, 13, 16, 17, 18, 22). Feature attention in the popular sports medicine and athletics literature has suggested recently that critical evaluation of the concept was overdue.

The Controversy over Biorhythms

There are basically two different views of biorhythms at the present time; a popular theory left over from the 1800s and a scientific method developed largely during the last 30 years. The key difference between these two views is the method by which biorhythms are determined. The popular theory is based only on a person's birth date, while the other is based on modern times-series analysis (TSA) techniques.

The popular theory was first introduced in the late 1800s by Fliess and Swoboda (35). Proponents of this theory maintain that each person has a fixed 23-day physical cycle, a fixed 28-day emotional cycle, and a fixed 33-day intellectual cycle. The lack of evidence for these fixed cycles has been cited (4, 17, 1) and verified in experimental measurements of cycle characteristics (9, 14). The amplitude or effect of these rhythms on the person is assumed to be identical for each rhythm and for each person. This simplistic theory further assumes that these rhythms begin at birth and are unvarying throughout one's lifetime. All cycle characteristics are assumed to have precisely fixed values that are identical for each person regardless of age, sex, health, environment, or other factors. The only variable is one's birth date. Once specified, this single parameter is supposed to precisely determine one's biorhythms for an entire lifetime.

In the scientific view, each person (or other biological organism) can have a unique pattern of rhythms, each of which is characterized by the usual amplitude, phase, and cycle length parameters used to describe periodic phenomena. These characteristics are determined by using well-established time-series analysis techniques (12, 25) on data collected over a period of time from each individual. Unlike the popular view in which virtually all of the characteristics are assumed in advance to be fixed, the scientific view makes no prior assumptions about the characteristics of the cycles.

Studies based on time-series analysis of data collected periodically from subjects have yielded information about the lengths of biorhythm cycles. An early study of emotional cycles in man found that subjects had different emotional cycle lengths ranging from 21 to 70 days (14). Another study of mood in one individual over a four-year period yielded an emotional cycle length of seven days (9).

CHAPTER III

PROCEDURES

The purpose of this chapter was to describe the procedures employed in the collection and evaluation of the data. This chapter was divided into the following areas:

1. Collection of data.
2. Population.
3. Selection and development of biorhythm charting methods.

Collection of Data

Injury data and birthdate data for this study were obtained from Kevin O'Neill, Oregon State University Head Athletic Trainer, who agreed to participate in the study. Data were the 1981 and 1982 season football injuries which occured throughout the entire season from the first day of practice through the last game. The injuries included those which occured during practice or game, but illness or any type of sickness was not to be included as an injury. The injured player must have been out of practice for one full day. Reoccurrence of the same injury was not included.

Population

The population consisted of one hundred and ninty two football players representing Oregon State University who were eligible for intercollegiate competition in accordance with rules established by the National Collegiate Athletic Association in the 1981 and 1982 seasons.

Selection and Development of Biorhythm Charting Methods

The method referred to as "biomathematics" as outlined by Thommen (35) was selected as the most appropriate procedure to calculate and chart the biorhythms of the injured football players. Although biorhythm charts of the sine-curve type show the up and down more dramatically, they should not be interpreted as indicating the degree or amplitude of the high or low points in a rhythm. To examine the accuracy of Thommen's charting method, the Dialgraf calculator was also used. The four factors used in this study as described by Thommen (35) were:

(1) The 23-day Physical Cycle. The physical cycle is divided into two periods with 11.5 days in the positive zone and 11.5 days in the negative of recharging phase. The first half of the physical cycle is a period of greater than usual energy, endurance, confidence, initiative and vitality. Athletes usually enjoy their greatest succeses during this period. During the second half, the recharging phase, endurance and resistance are low and physical effort is more of a strain.

(2) The 28-day Emotional Cycle. This rhythm is often referred to as the senstivity rhythm. The tendencies during the first half of emotional cycle which lasts 14 days, are for the individual to be optimistic, cheerful, outgoing and creative. The second half may bring moodiness, depression, negative reaction, and high sensitivity which may cause the individual to be easily upset.

(3) The 33-day Intellectual Cycle. Intellectual work of any kind is favored during the first half, 16.5 days of this cycle. Learning ability is heightened and so is memory. During the negative or recharging period, also lasting 16.5 days, it is not as easy to absorb new material or to retain it. The individual may be absent minded, forgetful or mentally sluggish. It is a time for review and practice rather than a period for absorption of new ideas or skills.

(4) The Critical Day Period. This is the day when an individual is switching from a positive to a negative phase or from a negative to a positive phase in any of the three cycles. If two rhythms are crossing to another zone at the same time, this is referred to as a double critical day; if all three rhythms are crossing to another zone on the same day, this is a triple critical day. Critical days in themselves are not dangerous. Rather, they are days during which the individual's reaction to his environment may bring about a critical situation.

The methods employed for charting the above mentioned four factors were as follows:

(1) The application of the calculation tables might best be described as triangluar calculation. Appendix A shows a number for each day of a year for each rhythm. These numbers correspond to every possible birthday in a year. Appendix B shows a complementary number for each year, from 1887 to 1984; these numbers apply to the year of birth. By combining the numbers

in Appendix A and B for any given date, the basic birth-date figures can be established. These figures, once established, do not change for that person; they are used in all future calculations. In order to chart the cycles for a given month, the numbers in Appendix C are merely added to the basic figures. Using birth date August 10, 1940 as an example, the calculation would be as follows:

	Physical 23-day Rhythm	Sensitivity 28-day Rhythm	Intellectual 33-day Rhythm
	10	4	11
	+17	+27	+28
Appendix A: August 10 Appendix B: 1940	27	31	39
If any of the totals is greater than 23, 28, or 33 respectively, then deduct.	-23	-28	-33
If smaller, carry down as is.	4	3	6

These are the basic figures for the birth date of August 10, 1940, selected for this example. These numbers (4, 3, and 6) can be used throughout the life of this person in conjunction with any of the figures listed in Appendix C, as shown below. In other words, the basic figures from the combination of Appendix A and B are fixed values in this method of calculating. By adding the third units from Appendix C the final position of each rhythm, as of the first day of the month selected for charting, can be obtained.

To complete this example, the rhythm figures for October, 1972, from Appendix C were calculated as follows:

	Physical 23-day Rhythm	Sensitivity 28-day Rhythm	Intellectual 33-day Rhythm
Basic birth-date, figures, as already shown.	4	3	6
Appendix C figures for October, 1972.	+7	+6	+20
	11	9	26
Again deduct 23, 28, or 33, respectively, when the totals are greater than these three figures.	-23	-28	-33
If smaller, carry down as is. Final net figures used for charting October, 1972.	11	9	26

These final figures (11 for the physical rhythm, 9 for the sensitivity rhythm, and 26 for the intellectual rhythm) show the exact position of each of the rhythms on October 1, 1972.

(2) To illustrate the biorhythm cycles a sine curve was selected as it provided a dramatic example of the oscillations. The curve indicates the relative changes in the cycles. The upper half of the cycle represents the plus or discharging periods, while the lower half represents the recuperative or minus periods.

(3) A biorhythm chart was utilized (see Figure 3).

Computerized cycle rulers were employed in order that the days of the computer calculated rhythms could be positioned over the first day of the desired month, the midline corresponding with the mid-line of the biorhythm chart, thus allowing the subsequent days and the rhythm positions to fall into line. The days were listed on the horizontal plane while the plus, critical and minus periods were listed on the vertical plane (see Figure 4).

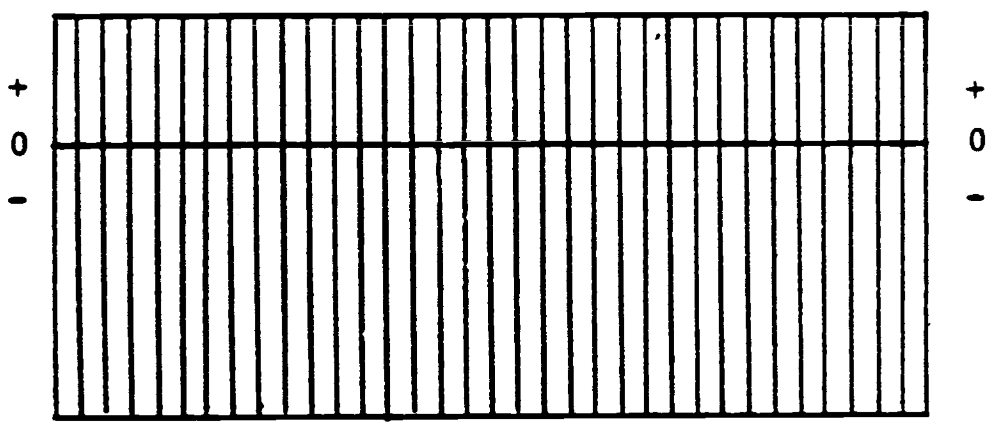
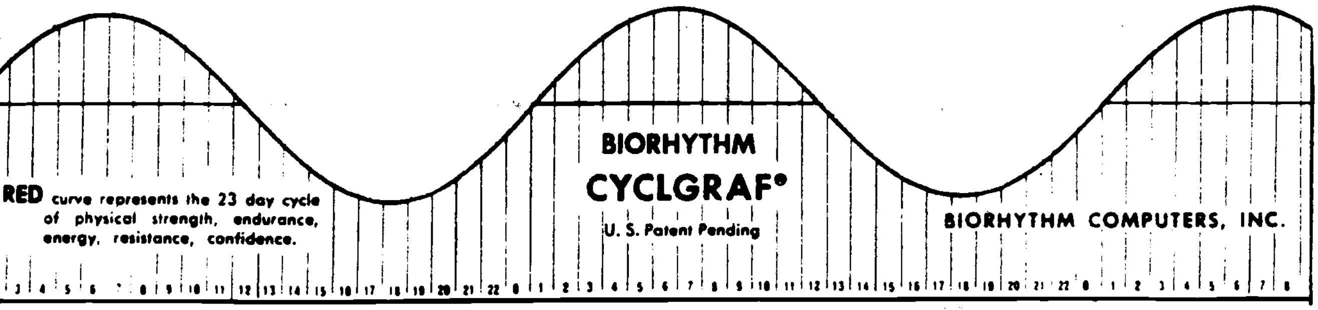


Fig. 3. Biological Rhythm Graph

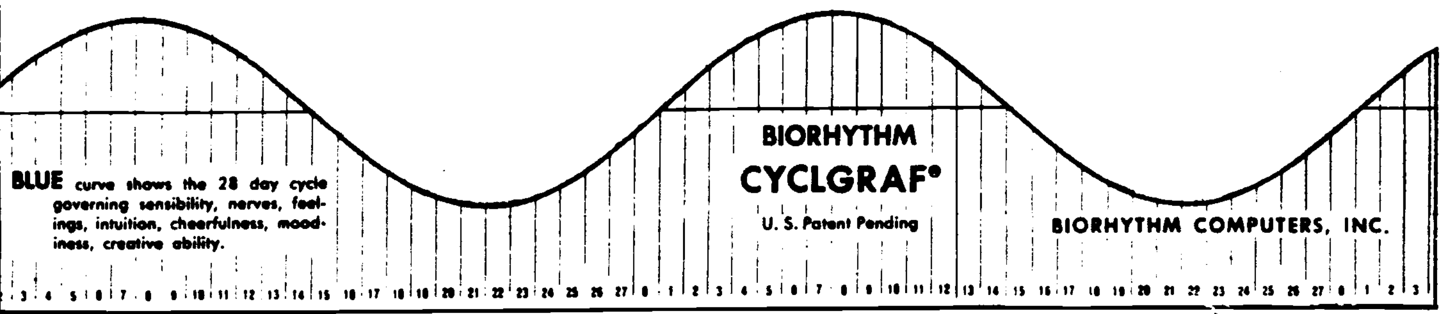
(4) The Dialgraf calculator was used to evaluate the accuracy of the Thommen's charting method. The Dialgraf is a unique invention of Swiss origin. It also is based upon the same Biomathematics as Thommen's method (35).

The dial type of calculator in Figure 5 shows the days of the week on the outside dial. The next dial shows the thirty-one days of the month, plus one extra day, which shows the cycle's position

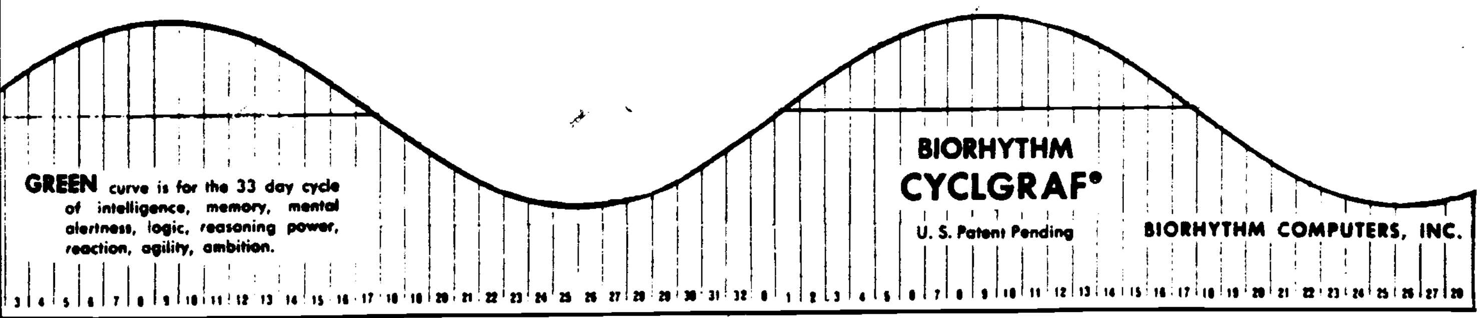
Left side of figure 4 missing from original.



23-Day Physical Cycle



28-Day Emotional Cycle



33-Day Intellectual Cycle

Figure 4 Biorhythm Cyclgraf

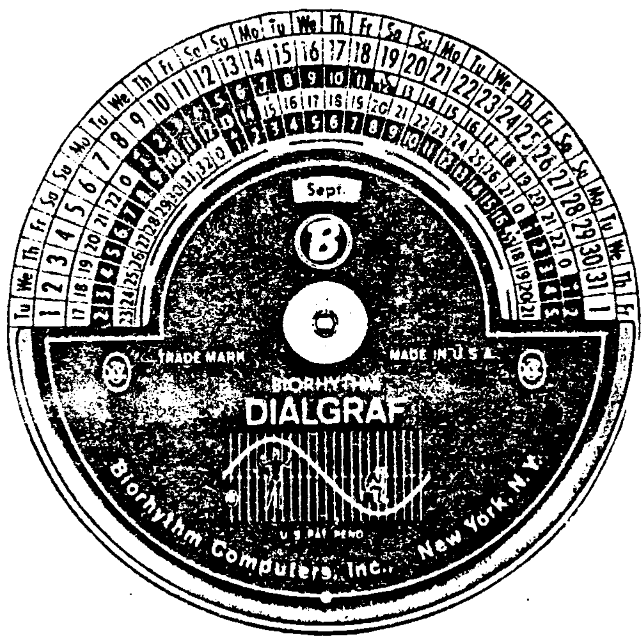


Figure 5 Dialgraf Calculator

on the following 31st. The third dial shows the 23-day physical rhythm. The first 11½ days, the plus position, are shown against red background; the second position, or minus position, of this rhythm is shown by red numerals on white. The fourth dial shows the 28-day emotional rhythm in a similar plus and minus arrangement, but in blue. Next, the 33-day intellectual rhythm is divided into two 16½-day periods in the same manner, but in green. A window dial is provided to show the month for which the Dialgraf can be set for any birth date and for any month one wishes to review. It shows each rhythm position in exact relation to the days of week and of the full month. The critical days are indicated by the change from the colored portion of a scale to the white one; in addition, small indicators point out the days of higher accident affinity.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this chapter was to present the statistical analysis of the data comparing the relationship between biorhythms and injuries to Oregon State University college football participants in the 1981 and 1982 seasons.

This chapter was organized into the following subdivisions:

(1) a statistical analysis of the hypothesis;

(2) a descriptive analysis;

(3) a discussion of the findings.

Statistical Analysis of the Hypothesis

To test the null hypothesis of no significant relationship between the position of the physical, emotional and intellectual biorhythm cycles, the critical day periods to football injuries, the data were statistically treated by the employment of percentages and chi square designs. The same procedures were also used for the double combination and triple combination of physical, emotional and intellectual biological rhythms. It is conventional in behavioral science research to use either a .05 or a .01 level of significance to determine the sucess of a hypothesis (29). The .05 level was selected to monitor this investigation because it seemed to allow sufficient variation to permit acceptance or rejection of the hypothesis. Significance was set at the .05 level. The primary objectives were to investigate the possible relationship between football injuries and the critical days of the biological rhythms.

The subtopics to the statistical analysis of injuries are as follows: tabulation of data; statistical preparation for chi square analysis;

Tabulation of Data

The following tables provide the tabulation of data of the injured players during 1981 and 1982 seasons. Table 1 presents the number of injuries recorded in this study. The total number of injuries which occured in the 1981 and 1982 seasons were 82 and 127.

There was a difference of forty five injuries between the 1981 and 1982 seasons. This difference can be explained as a result of 17 players having more than one injury in the 1982 season.

Table 1

Number of Injuries Recorded

1981	1982	Total
82	127	209

Table 2 illustrates the number of critical days calculated for injured players in 1981 and 1982 seasons. Thirty five and thirteen critical days were recorded in 1981 and 1982 seasons. Critical days calculated in 1982 season were nearly 2.7 times as many as those in 1981 season. Twenty three percent of injuries occurred on the critical day of the biological rhythms. No injury was recorded on the critical days of the combination of physical, emotional and intellectual biological rhythms.

Table 3 lists the incidence of football injuries by anatomical location.

Table 2

Number of Critical Days

	81 Season	82 Season	Total
Single Physical	3	14	17
Single Emotional	6	4	10
Single Intellectual	1	13	14
Double Critical (P and E)	1	2	3
Double Critical (E and I)	1	0	1
Double Critical (P and I)	1	2	3
Triple Critical (P, E and I)	0	0	0
Total	13	35	48

* P= Physical Cycle
E= Emotional Cycle
I= Intellectual Cycle

Table 3

Incidence of Injury by Anatomical Location

Anatomic Location	81	82	Total	%
Sternum		2	2	1%
Ankle Joint	20	14	34	16%
Elbow Joint	2	4	6	3%
Foot	8	9	17	8%
Hand	3	12	15	7%
Hamstring	3	10	13	6%
Head	7	3	10	5%
Knee Joint	18	29	47	22%
Hip	3	9	12	6%
Quadriceps	4	3	7	3%
Ribs	1	3	4	2%
Shoulder Joint	6	16	22	11%
Lower Back	3	7	10	5%
Achilles Tendon		2	2	1%
Groin	4	4	8	4%
Total	82	127	209	100%

Statistical Preparation for Chi Square Analysis

The probability of occurence of critical day, or zero crossing of biorhythm curve can be calculated if all of the zero crossings of the three cycles in a year are added and divided by the number of days in a year. In other words, during the span of a biorhythmic life (58 years and 67 or 68 days), man experiences 16,925 days of mixed rhythms and 4,327 days on which a switch takes place. A full biorhythmic span is the result of multiplying 23 x 28 x 33 days, a total of 21,252 days. It is these switch days that are considered potentially critical because then man is believed to show a higher degree of the instability leading to accident, human error, and death affinity. Expressed in percentage, this theoretical ratio is 79.6 percent mixed-rhythm days and 20.4 percent critical days (35).

The expected percentage occurence of critical days for this analysis was presented in table 4 (2).

The Critical Days of Biological Rhythms

To analyze the data to determine if a relationship existed between the critical days of football players and the occurrence of injuries, chi square goodness of fit test was used. The chi square value of 14.07 for 7 df at .05 significance level was needed for rejection of the null hypothesis. The calculated chi square value was 10.69; therefore, the null hypothesis of no significant relationship

Table 4 Expected Percentage Occurrences of Critical Periods

Critical	24 Hour Period
Single Physical (P)	7.5850 %
Single Emotional (E)	6.1265 %
Single Intellectual (I)	5.1383 %
Double Critical (P and I)	.5835 %
Double Critical (E and I)	.4894 %
Double Critical (I and P)	.3953 %
Triple Critical (P, E and I)	.0376 %
Total Critical	20.3557 %
Total Non Critical	79.6443 %

between the critical days of biological rhythm and football injuries was accepted.

Table 5 illustrates the mechanics of the chi square analysis.

Physical Biological Rhythm

In order to determine if there was any significance difference between the physical biological rhythm characteristics of individual players and the occurrence of football injuries, chi square was used. The chi square table value of 3.84 for 1 df at the .05 level was needed for significance. The calculated chi square value was 0.96; therefore, the null hypothesis of no significant relationship between physical biological rhythm and football injuries was accepted.

Table 6 illustrates the mechanics of the chi square analysis.

Table 5

Non-Critical Days and Critical Days

Day	Observed Injuries	Expected Injuries
Non-Critical	162	166.5
Physical Critical	17	15.9
Emotional Critical	10	12.8
Intellectual Critical	14	10.7
Double Critical (P+E)	3	1.2
Double Critical (E+I)	1	0.8
Double Critical (P+I)	3	0.8
Triple Critical (P+E+I)	0	0.1

* P= Physical Cycle
E= Emotional Cycle
I= Intellectual Cycle

$X^2 = 10.69$

* X^2 of 14.07 needed for df=7 at .05 significance level

Table 6

Chi Square Analysis for Physical Biological Rhythm

	Non-Critical	Critical
Expected	190.2	18.8
Observed	186	23

$X^2 = 0.96$

* X^2 of 3.84 needed for significance at .05 level

Emotional Biological Rhythm

The data were analyzed for the emotional cycle using the same procedures as were utilized for the physical cycle. A chi square table value of 3.84 for 1 df at .05 level was needed for rejection of the null hypothesis. The calculated chi square value was 0.02; therefore, the null hypothesis of no significant relationship between the emotional biological rhythm and football injuries was accepted.

Table 7 illustrates the mechanics of the chi square analysis.

Intellectual Biological Rhythm

The data were analyzed for the intellectual cycle using the same procedures. A chi square table value of 3.84 for 1 df at .05 level was needed for rejection of the null hypothesis. The calculated chi square value was 2.57; therefore, the null hypothesis of no significant relationship between the intellectual biological rhythm and football injuries was accepted.

Table 8 illustrates the mechanics of the chi square analysis.

Table 7

Chi Square Analysis for Emotional Biological Rhythm

	Non-Critical	Critical
Expected	194.4	14.6
Observed	195	14

$X^2 = 0.02$

* X^2 of 3.84 needed for significance at .05 level

Table 8

Chi Square Analysis for Intellectual Biological Rhythm

	Non-Critical	Critical
Expected	196.5	12.5
Observed	191	18

$X^2 = 2.57$

* X^2 of 3.84 needed for significance at .05 level

The Combination of Physical and Emotional Rhythms

An analysis of the data between the combination of physical and emotional biological rhythms and the occurrence of football injuries revealed that there was no significant relationship at .05 level.

Table 9 illustrates the mechanics of chi square analysis.

Table 9

Chi Square Analysis for the Combination of Physical and Emotional Biological Rhythms

	Non-Critical	Critical
Expected	177.2	31.8
Observed	175	34

$X^2 = 0.18$

* X^2 of 3.84 needed for significance at .05 level.

The Combination of Emotional and Intellectual Biological Rhythms

An analysis of the data between the combination of Emotional and intellectual biological rhythms and the occurrence of football injuries revealed that there was no significant relationship at the .05 level.

Table 10 illustrates the mechanics of the chi square analysis.

Table 10

Chi Square Analysis for the Combination of Emotional and Intellectual Biological Rhythms

	Non-Critical	Critical
Expected	182.2	26.8
Observed	178	31

$X^2 = 0.76$

* X^2 of 3.84 needed for significance at .05 level.

<u>The Combination of Intellectual and Physical Biological Rhythms</u>

An analysis of the data between the combination of intellectual and physical biological rhythms and the occurrence of football injuries revealed that there was no significant relationship at the .05 level.

Table 11 illustrates the mechanics of the chi square analysis.

Table 11

Chi Square Analysis for the Combination of Intellectual and Physical Biological Rhythms

	Non-Critical	Critical
Expected	179.3	29.7
Observed	171	38

$X^2 = 1.33$

* X^2 of 3.84 needed for significance at .05 level.

<u>The Combination of Physical, Emotional and Intellectual Biological Rhythms</u>

An analysis of the data between the combination of physical, emotional and intellectual biological rhythms and the occurrence of football injuries revealed that there was no significant relationship at the .05 level.

Table 12 illustrates the mechanics of the chi square analysis.

Table 12

Chi Square Analysis for the Combination of Physical, Emotional and Intellectual Biological Rhythms

	Non-Critical	Critical
Expected	166.4	42.6
Observed	161	48

$X^2 = 0.86$

* X^2 of 3.84 needed for significance at .05 level

A Descriptive Analysis by Means of Percentage

The purpose of this section was to analyze and provide descriptive explanation of the data by use of percentages. The information was tabulated in percentages and graphed for the purpose of describing other information concerning injuries.

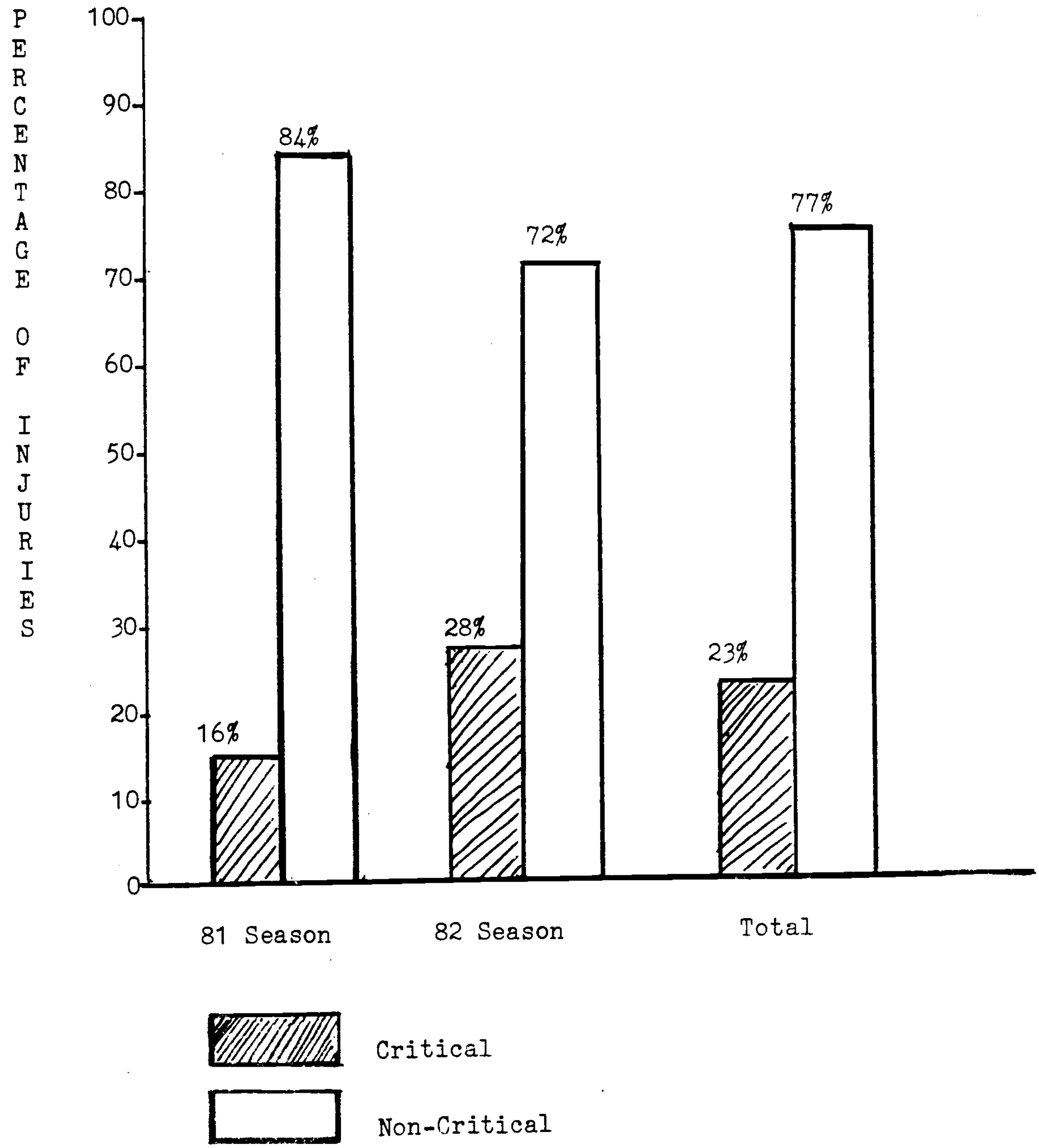
A comparison was made of the total number of injuries which occurred on critical days and non-critical days. The percentage of the total number of injuries which occurred on critical days was 16%, 28%, in 1981 and 1982. The combined percentage was 23%. An analysis was made of the total number of injuries which occurred each biological critical day.

The percentage of the total number of injuries which occurred on physical critical, emotional critical and intellectual critical days was 35%. 29% and 21%. The percentage of injuries on double critical days of physical and emotional, emotional and intellectual and physical and intellectual was 6%, 6% and 2%. The percentage of injuries on triple critical days was zero%. These data are illustrated in Graph 2.

Table 3 lists the incidence of injury by anatomical location. An analysis was made of the total number of injuries by anatomical location. The percentage of knee injuries, ankle and upper leg was 22%, 16% and 13%. These data are illustrated in Graph 3.

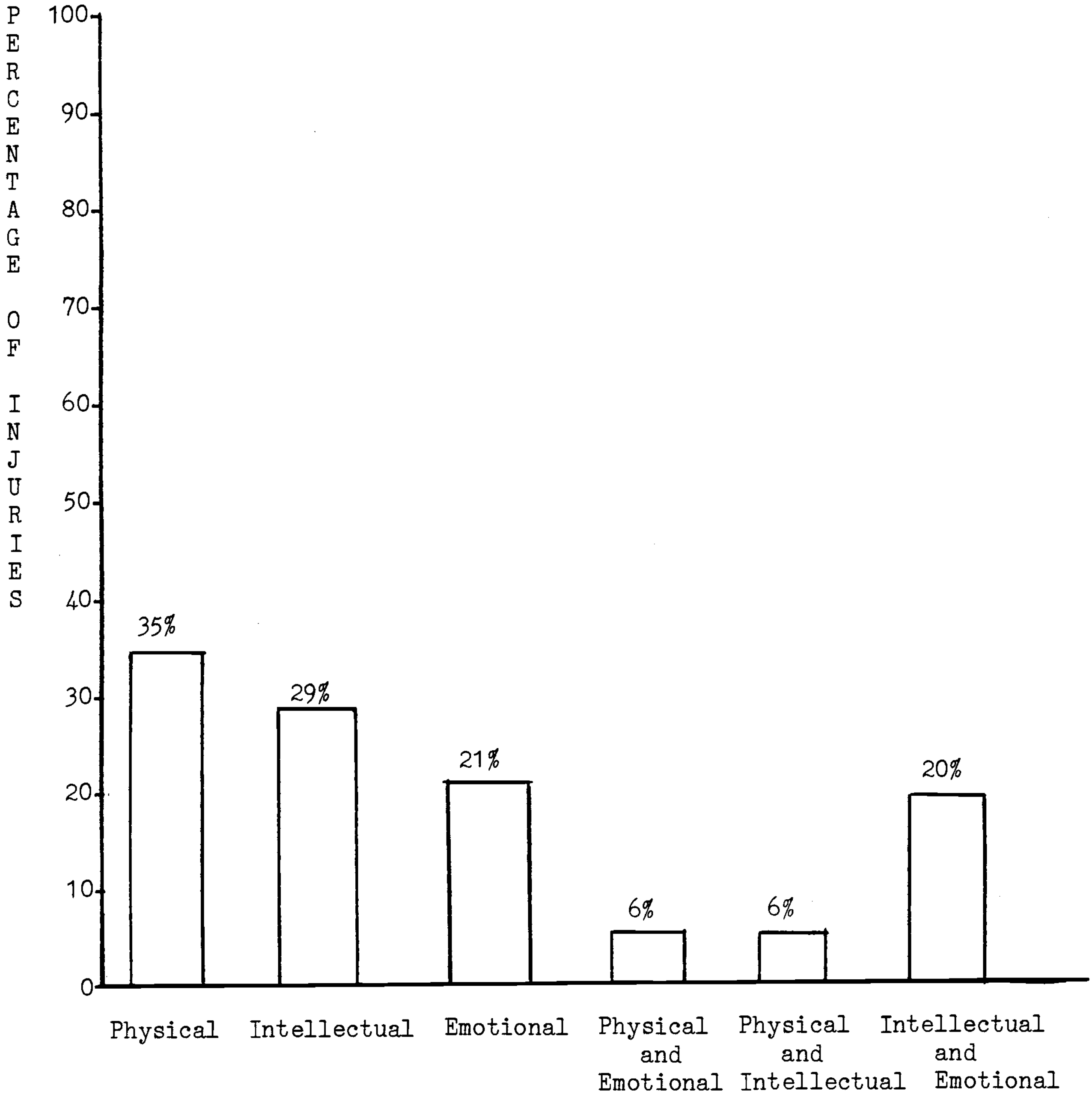
Graph 1

Percentage of Injuries on Critical Days
and Non-Critical Days



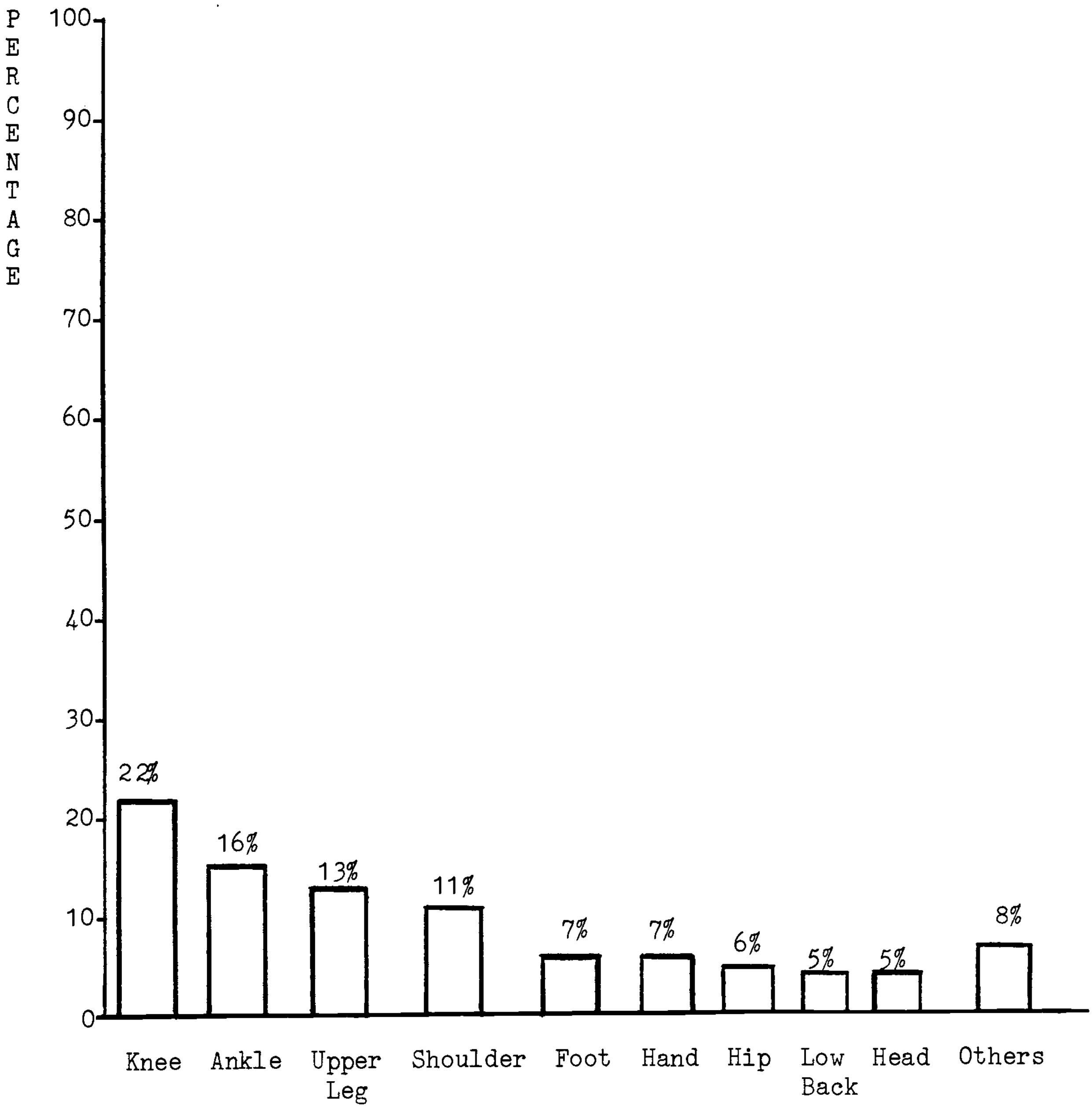
Graph 2

Percentage of Injuries on Each
Biological Critical Day



Graph 3

Incidence of Injury by Anatomical Location



Discussion of the Findings

The lack of evidence between football injury and the position of biorhythms may provide evidence that the predictive potential of biological rhythms is invalid and unreliable.

A statistical analysis by means of chi square design and percentages was used to compare the relationship of the critical days, physical, emotional and intellectual biological rhythm cycles to football injuries. The first hypothesis stated that there would be no significant relationship between the critical days of biological rhythms and the occurrence of football injuries. The analysis of data substantiated the hypothesis of no significant relationship between the critical days of biological rhythm and football injury although 23% of total number football injuries occurred on critical days. Therefore, the injuries on a critical day can be explained to occur by chance.

The second hypothesis stated that there would be no significant relationship between the physical biological rhythm of football players and the occurrence of football injuries. This hypothesis was confirmed by the use of the chi square statistical analysis. The third hypothesis stated that there would be no significant relationship the emotional biological rhythm of football players and the occurrence of injuries. The hypothesis was confirmed by the use of chi square statistical analysis. The fourth hypothesis stated that there would be no significant relationship between the intellectual biological rhythm of football players and the occurrence of football injuries. The null hypothesis was accepted by the use of chi square statistical analysis. The fifth hypothesis stated that there would be no significant relationship between the combination of physical and emotional biological rhythms and the occurrence of football injuries. The null hypothesis was confirmed by the use of the chi square statistical analysis. The sixth hypothesis stated that there would be no significant relationship between the combination of emotional and intellectual biological rhythms and the occurrence of football injuries. The null hypothesis was confirmed by the use of the chi square statistical analysis. The seventh hypothesis stated that there would be no significant relationship between the combination of intellectual and physical biological rhythms and the occurrence of football injuries. The null hypothesis was confirmed by the use of the chi square statistical analysis. The eighth hypothesis stated that there would be no significant relationship between the combination of physical, emotional and intellectual biological rhythms. The null hypothesis was accepted by the use of chi square statistical analysis. In all of the above analysis, the eight null hypotheses were accepted due to the lack of critical days calculated in the study. It should be mentioned that the percentage of the total number of injuries which occurred on physical critical days was 35%. The knee (22%) was the most frequent anatomical location of total number of football injuries. The second anatomical location was ankle (16%), and the third was upper leg (13%).

The findings of the study are such that none of the eight null hypotheses could be rejected. The development of a statistical model for the study of biorhythms is dependent upon the researcher's interpretation of the theory.

The most frequently used method for testing the theory is to test previous injury data for correlation with the critical and low periods. This is possible because knowing only the birth date of the individual involved enables calculation of biorhythm on the date of the injury. In general, people born during the morning hours will experience their critical period during the day calculated for their actual birthday; however, people born later in the day may find their critical periods overlap into the next day (2).

Therefore, knowing the hour of birth, or at least the approximate time of the day, makes it possible to calculate the biological rhythm cycles more accurately.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

In the preceding chapters, the problem was reviewed, the related literature was reviewed, the methods used in attempting to solve the problem were discussed, and the statistical analysis of the data was reported. This final chapter is divided into the following sub-divisions: (1) the summary (2) the findings (3) the conclusions, and (4) the recommendations.

Summary

The general problem was to determine the relationship between biorhythms and injuries to college football participants representing Oregon State University. The sub-problems were to determine a method for charting the selected biological rhythms and to determine the incidence of football injuries by anatomical location. The population consisted of one hundred and ninty two football players representing Oregon State University who participated in the intercollegiate football seasons of 1981 and 1982. There were 209 football injuries reported during the study.

A relationship was examined between the football players injuries and the critical days, the 23-day physical, the 28-day emotional, the 33-day intellectual biological rhythm, the double combination and the triple combination of physical, emotional and intellectual biological rhythms. The injury data were recorded for each year and added for total number of injuries. The two year injuries were also treated statistically by percentage and chi square. In addition, a statistical analysis through percentages, and illustration by the use of graphs, was provided for the other findings in the study.

For the purpose of this study, the following hypotheses were stated in null form with acceptance set at the .05 level of significance.

1. There will be no significant relationship between the critical days of the biorhythm of individual players and the occurrence of football injuries.
2. There will be no significant relationship between the physical biorhythm cycles of individual football players and the occurrence of football injuries.
3. There will be no significant relationship between the emotional biorhythm cycle of individual players and the occurrence of football injuries.
4. There will be no significant relationship between the intellectual biorhythm cycle of individual players and the occurrence of football injuries.
5. There will be no significant relationship between the combination of physical and emotional biological rhythms and the occurrence of football injuries.
6. There will be no significant relationship between the combination of emotional and intellectual biological

rhythms and the occurrence of football injuries.

7. There will be no significant relationship between the combination of intellectual and physical biological rhythms and the occurrence of football injuries.

8. There will be no significant relationship between the combination of physical, emotional and intellectual biological rhythms and the occurrence of football injuries.

Findings

In relation to the hypothesis stated in Chapter 1, the analysis of data revealed the following findings:

Hypothesis Number One

The statistical analysis substantiated the hypothesis that there was no significant relationship between the critical days of the biorhythm of individual players and the occurrence of football injuries. Therefore, the first null hypothesis was statistically accepted.

Hypothesis Number Two

The statistical analysis substantiated the hypothesis that there was no significant relationship between the physical biorhythm cycles of individual football players and the occurrence of football injuries. Therfore, the second null hypothesis was statistically accepted.

Hypothesis Number Three

The statistical analysis substantiated the hypothesis that there was no significant relationship between the emotional biorhythm cycle of individual players and the occurrence of football injuries. Therefore, the third null hypothesis was statistically accepted.

Hypothesis Number Fourth

The statistical analysis substantiated the hypothesis that there was no significant relationship between the intellectual biorhythm cycle of individual players and the occurrence of football injuries. Therefore, the fourth null hypothesis was statistically accepted.

Hypothesis Number Fifth

The statistical analysis substantiated the hypothesis that there was no significant relationship between the combination of physical and emotional biological rhythms and the occurrence of football injuries. Therefore, the fifth null hypothesis was statistically accepted.

Hypothesis Number Sixth

The statistical analysis substantiated the hypothesis that there was no significant relationship between the combination of emotional and intellectual biological rhythms and the occurrence of football injuries. Therefore, the sixth null hypothesis was statistically accepted.

Hypothesis Number Seventh

The statistical analysis substantiated the hypothesis that there was no significant relationship between the combination of intellectual and physical biological rhythms and the occurrence of football injuries. Therefore, the seventh null hypothesis was statistically accepted.

Hypothesis Number Eighth

The statistical analysis substantiated the hypothesis that there was no significant relationship between the combination of physical, emotional and the intellectual biological rhythms and the occurrence of football injuries. Therefore, the eighth null hypothesis was statistically accepted.

Conclusions

Based upon the analysis of the data, the following conclusions were deemed appropriate for this study:

1. There is no relationship between the critical days of the biorhythm of individual players and the occurrence of football injuries.

2. There is no relationship between the physical, the emotional and the intellectual biological rhythms and the occurrence of football injuries.

3. There is no relationship between the double combination and triple combination of physical, emotional and intellectual biological rhythms and the occurrence of football injuries.

Recommendations

Based upon the findings of this study, the following recommendations were made for future research in the area.

1. A study be conducted using a population of which the exact time of birth is known so the biorhythm cycles and critical day periods can be precisely measured.

2. A study be conducted dealing with non-contact sports, in which the exogenous factor of contact be eliminated.

3. A study be conducted using oriental type of biological rhythm charting method and modern time-series analysis which relate biological rhythm and sport injuries.

REFERENCES

1. Ahlgren, A. Biorhythms. International Journal of Chronobiology, 1974; 2: 107-9.

2. Albert Thmann, P.E. Biorhythms and Industrial Safety. The Fairmont Press.

3. Aschoff, J. Circadian Rhythms in Man. Science, 148, 1427-1432, 1965.

4. Berube, B.P. Absence of correlation between measured performance in college students and biorhythm information calculated from their individual birth dates. Unpublished doctoral dissertation. The George Washington University, Washington, D.C., 1977.

5. Blyth, C.S. and Arnold, D.C. Forty-Seventh Annual Survey of Football Fatalities. 1931-1978, American Football Coaches Association, National Collegiate Athletic Association, and National Federations of State High School Association, 1979.

6. Cohen, D. Biorhythms in Tour Life. Greenwich, CT: Fawcett, 1976, p.192.

7. Daniel, D. Arnheim and Klafs, Carle. Modern Principles of Athletic Training. ST. Lous, The C.V. Mosby Company, 1981.

8. Dolan, M.H. Biorhythms and Accidents in School Children. Abstracts of Hospital Management Studies, 1976; 13(2).

9. Dorland, J. and Brinker, N. Fluctuations in Human Mood (A Preliminary Study). Journal of Interdisciplinary Cycle Research, 1973; 4(1): 25-9.

10. Gardiner, M. Mathematical Games. Scientific American 1966; 215(1), 108-12.

11. Gittelson, Bernard. Biorhythm, a Personal Science. New York: Arco Publishing Co., Inc., 1975.

12. Halberg, F. and Stien, M. Computer Techniques in the Study of Biological Rhythms. Annals of the New York Academy of Sciences, 1964; 115: 695-720.

13. Halverson, S.G. The Effect of Biorhythms on the Patient with a Myocardial infarction. Abstracts of Hospital Management Studies, 1976; 13(2).

14. Hersey, P. Emotional Cycle in Man. Journal of Mental Science, 1931; 77: 151-69.

15. Johnson, Dale. A Relationship of Selected Biological Rhythms to Football Injuries. Unpublished Doctoral Dissertation, University of Utah, 1974.

16. Kauth, W.O. Biorhythms and Acute Myocardial Infarction. Unpublished Doctoral Dissertation, University of Utah, Salt Lake City, 1976.

17. Khalil, T.M. and Kurucz, C.N. The Influence of 'Biorhythm' on Accident Occurrence and Performance. Ergonomics, 1977; 20(4), 389-398.

18. King, K.B. A comparison of Biorhythm Cycles and Surgical Complications. Abstracts of Hospital Management Studies, 1976; 13(2).

19. Krauze-Poray, B.J. Basic Biorhythms: Nature's Biological Master Clock. Brisbane, Australia: Biorhythm Research and Information Center, 1976, p.164.

20. Kuhn, Robert I. "Control Your Destiny with Biorhythms." Fiesta, January, 1975.

21. Larry, T. Analysis of Selected Physiological Variables and Selected Biological Rhythms in the Performance of Track and Field Competitors. Unpublished Doctoral Dissertation, University of Utah, 1976.

22. Latman, N. Human Sensitivity, Intellectual, and Physical cycles and Motor Vehicle Accidents. Accident Analysis and Prevention, 1977; 9(2): 109-12.

23. Luce, Gay Gaer. Biological Rhythms in Human and Animal Physiology. New York: Dover Publications, Inc., 1971.

24. Luce, G.G. Body Time. New York: Pantheon Books, 1971.

25. Luce, G.G. Biological Rhythms in Psychiatry and Medicine. Chevy Chase, Maryland: National Institute of Mental Health, Department of Health, Education, and Welfare, 1970.

26. Mallardi, V. Biorhythms and Your Behaviour. Philadelphia: Running Rress, 1978, p.80.

27. Martin, John L. Relationship of Selected Biological Rhythms to Performance of Competitive Swimmers. Unpublished Doctoral Dissertation, University of Utah, 1973.

28. O'Neil, Barbara, & Phillips, Richard. Biorhythms: How to Live with Your Life Cycles. Pasadena, California: Ward Ritchie Press, 1975.

29. Popham, W.J. and Sirotnik, K.A. Educational Statistics. 2nd New York: Harper and Row, Publishers, 1973.

30. Renbourn, E.T. Variation, Diurnal and Over Longer Periods of Time, in Blood Hemoglobin, Hematocrit, Plasma Protein, Erythrocyte Sedimentation Rate, and Blood Chloride. Journal of Hygiene, 1947, 45, 445.

31. Rippman, R. Biorhythm and the Athlete. Scholastic Coach, 48: 48, 1978.

32. Roy Steven and Richard Irvin Sports Medicine. New Jersey Prentice-Hall, Inc, 1983.

33. Sollenberger, A. Biological Rhythm Research. Amsterdam: Elaevier, 1965.

34. Still, Henry. Of Time, Tides, and Inner Clocks. Harrisburg, Pennsylvania: Stackpole Books, 1972.

35. Thommen, George S., Is This Your Day?, Avon Books, New York, 1976.

36. Ward, Ritchie R. The Living Clocks. New York: Alfred A. Knopf, 1971.

37. Wenos, John, and Katherine Wenos. "We All Got Rhythm." Track and Field News, April, 1974.

38. Wenli, H. J. Biorhythm. New York: Cornerstone Library, 1976, p.128.

A P P E N D I X

APPENDIX A

Key Figures for Day of Birth

JANUARY

	23-Day Cycle	28-Day Cycle	33-Day Cycle
1	1	1	1
2	0	0	0
3	22	27	32
4	21	26	31
5	20	25	30
6	19	24	29
7	18	23	28
8	17	22	27
9	16	21	26
10	15	20	25
11	14	19	24
12	13	18	23
13	12	17	22
14	11	16	21
15	10	15	20
16	9	14	19
17	8	13	18
18	7	12	17
19	6	11	16
20	5	10	15
21	4	9	14
22	3	8	13
23	2	7	12
24	1	6	11
25	0	5	10
26	22	4	9
27	21	3	8
28	20	2	7
29	19	1	6
30	18	0	5
31	17	27	4

FEBRUARY

	23-Day Cycle	28-Day Cycle	33-Day Cycle
1	16	26	3
2	15	25	2
3	14	24	1
4	13	23	0
5	12	22	32
6	11	21	31
7	10	20	30
8	9	19	29
9	8	18	28
10	7	17	27
11	6	16	26
12	5	15	25
13	4	14	24
14	3	13	23
15	2	12	22
16	1	11	21
17	0	10	20
18	22	9	19
19	21	8	18
20	20	7	17
21	19	6	16
22	18	5	15
23	17	4	14
24	16	3	13
25	15	2	12
26	14	1	11
27	13	0	10
28	12	27	9
29	11	26	8

MARCH

	23-Day Cycle	28-Day Cycle	33-Day Cycle
1	11	26	8
2	10	25	7
3	9	24	6
4	8	23	5
5	7	22	4
6	6	21	3
7	5	20	2
8	4	19	1
9	3	18	0
10	2	17	32
11	1	16	31
12	0	15	30
13	22	14	29
14	21	13	28
15	20	12	27
16	19	11	26
17	18	10	25
18	17	9	24
19	16	8	23
20	15	7	22
21	14	6	21
22	13	5	20
23	12	4	19
24	11	3	18
25	10	2	17
26	9	1	16
27	8	0	15
28	7	27	14
29	6	26	13
30	5	25	12
31	4	24	11

APPENDIX A — continued

Key Figures for Day of Birth

APRIL				MAY				JUNE			
	23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle
1	3	23	10	1	19	21	13	1	11	18	15
2	2	22	9	2	18	20	12	2	10	17	14
3	1	21	8	3	17	19	11	3	9	16	13
4	0	20	7	4	16	18	10	4	8	15	12
5	22	19	6	5	15	17	9	5	7	14	11
6	21	18	5	6	14	16	8	6	6	13	10
7	20	17	4	7	13	15	7	7	5	12	9
8	19	16	3	8	12	14	6	8	4	11	8
9	18	15	2	9	11	13	5	9	3	10	7
10	17	14	1	10	10	12	4	10	2	9	6
11	16	13	0	11	9	11	3	11	1	8	5
12	15	12	32	12	8	10	2	12	0	7	4
13	14	11	31	13	7	9	1	13	22	6	3
14	13	10	30	14	6	8	0	14	21	5	2
15	12	9	29	15	5	7	32	15	20	4	1
16	11	8	28	16	4	6	31	16	19	3	0
17	10	7	27	17	3	5	30	17	18	2	32
18	9	6	26	18	2	4	29	18	17	1	31
19	8	5	25	19	1	3	28	19	16	0	30
20	7	4	24	20	0	2	27	20	15	27	29
21	6	3	23	21	22	1	26	21	14	26	28
22	5	2	22	22	21	0	25	22	13	25	27
23	4	1	21	23	20	27	24	23	12	24	26
24	3	0	20	24	19	26	23	24	11	23	25
25	2	27	19	25	18	25	22	25	10	22	24
26	1	26	18	26	17	24	21	26	9	21	23
27	0	25	17	27	16	23	20	27	8	20	22
28	22	24	16	28	15	22	19	28	7	19	21
29	21	23	15	29	14	21	18	29	6	18	20
30	20	22	14	30	13	20	17	30	5	17	19
				31	12	19	16				

APPENDIX A — continued

Key Figures for Day of Birth

JULY				AUGUST				SEPTEMBER			
	23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle
1	4	16	18	1	19	13	20	1	11	10	22
2	3	15	17	2	18	12	19	2	10	9	21
3	2	14	16	3	17	11	18	3	9	8	20
4	1	13	15	4	16	10	17	4	8	7	19
5	0	12	14	5	15	9	16	5	7	6	18
6	22	11	13	6	14	8	15	6	6	5	17
7	21	10	12	7	13	7	14	7	5	4	16
8	20	9	11	8	12	6	13	8	4	3	15
9	19	8	10	9	11	5	12	9	3	2	14
10	18	7	9	10	10	4	11	10	2	1	13
11	17	6	8	11	9	3	10	11	1	0	12
12	16	5	7	12	8	2	9	12	0	27	11
13	15	4	6	13	7	1	8	13	22	26	10
14	14	3	5	14	6	0	7	14	21	25	9
15	13	2	4	15	5	27	6	15	20	24	8
16	12	1	3	16	4	26	5	16	19	23	7
17	11	0	2	17	3	25	4	17	18	22	6
18	10	27	1	18	2	24	3	18	17	21	5
19	9	26	0	19	1	23	2	19	16	20	4
20	8	25	32	20	0	22	1	20	15	19	3
21	7	24	31	21	22	21	0	21	14	18	2
22	6	23	30	22	21	20	32	22	13	17	1
23	5	22	29	23	20	19	31	23	12	60	0
24	4	21	28	24	19	18	30	24	11	15	32
25	3	20	27	25	18	17	29	25	10	14	31
26	2	19	26	26	17	16	28	26	9	13	30
27	1	18	25	27	16	15	27	27	8	12	29
28	0	17	24	28	15	14	26	28	7	11	28
29	22	16	23	29	14	13	25	29	6	10	27
30	21	15	22	30	13	12	24	30	5	9	26
31	20	14	21	31	12	11	23				

APPENDIX A — continued

Key Figures for Day of Birth

	OCTOBER				NOVEMBER				DECEMBER		
	23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle
1	4	8	25	1	19	5	27	1	12	3	30
2	3	7	24	2	18	4	26	2	11	2	29
3	2	6	23	3	17	3	25	3	10	1	28
4	1	5	22	4	16	2	24	4	9	0	27
5	0	4	21	5	15	1	23	5	8	27	26
6	22	3	20	6	14	0	22	6	7	26	25
7	21	2	19	7	13	27	21	7	6	25	24
8	20	1	18	8	12	26	20	8	5	24	23
9	19	0	17	9	11	25	19	9	4	23	22
10	18	27	16	10	10	24	18	10	3	22	21
11	17	26	15	11	9	23	17	11	2	21	20
12	16	25	14	12	8	22	16	12	1	20	19
13	15	24	13	13	7	21	15	13	0	19	18
14	14	23	12	14	6	20	14	14	22	18	17
15	13	22	11	15	5	19	13	15	21	17	16
16	12	21	10	16	4	18	12	16	20	16	15
17	11	20	9	17	3	17	11	17	19	15	14
18	10	19	8	18	2	16	10	18	18	14	13
19	9	18	7	19	1	15	9	19	17	13	12
20	8	17	6	20	0	14	8	20	16	12	11
21	7	16	5	21	22	13	7	21	15	11	10
22	6	15	4	22	21	12	6	22	14	10	9
23	5	14	3	23	20	11	5	23	13	9	8
24	4	13	2	24	19	10	4	24	12	8	7
25	3	12	1	25	18	9	3	25	11	7	6
26	2	11	0	26	17	8	2	26	10	6	5
27	1	10	32	27	16	7	1	27	9	5	4
28	0	9	31	28	15	6	0	28	8	4	3
29	22	8	30	29	14	5	32	29	7	3	2
30	21	7	29	30	13	4	31	30	6	2	1
31	20	6	28					31	5	1	0

APPENDIX B

Key Figures for Year of Birth

* LY indicates leap years
** 1900 was not a leap year.

People born in a leap year between March and December must deduct 1 day from the value shown in each cycle.

For those born in a leap year between January 1 and February 29, the values shown in this chart remain as they are.

	23-Day Cycle	28-Day Cyale	33-Day Cycle		23-Day Cycle	28-Day Cycle	33-Day Cycle
1887	9	9	15	1920 LY	9	25	8
1888 LY	12	8	13	1921	11	23	5
1889	14	6	10	1922	14	22	3
1890	17	5	8	1923	17	21	1
1891	20	4	6	1924 LY	20	20	32
1892 LY	0	3	4	1925	22	18	29
1893	2	1	1	1926	2	17	27
1894	5	0	32	1927	5	16	25
1895	8	27	30	1928 LY	8	15	23
1896 LY	11	26	28	1929	10	13	20
1897	13	24	25	1930	13	12	18
1898	16	23	23	1931	16	11	16
1899	19	22	21	1932 LY	19	10	14
1900**	22	21	19	1933	21	8	11
1901	2	20	17	1934	1	7	9
1902	5	19	15	1935	4	6	7
1903	8	18	13	1936 LY	7	5	5
1904 LY	11	17	11	1937	9	3	2
1905	13	15	8	1938	12	2	0
1906	16	14	6	1939	15	1	31
1907	19	13	4	1940 LY	18	0	29
1908 LY	22	12	2	1941	20	26	26
1909	1	10	32	1942	0	25	24
1910	4	9	30	1943	3	24	22
1911	7	8	28	1944 LY	6	23	20
1912 LY	10	7	26	1945	8	21	17
1913	12	5	23	1946	11	20	15
1914	15	4	21	1947	14	19	13
1915	18	3	19	1948 LY	17	18	11
1916 LY	21	2	17	1949	19	16	8
1917	0	0	14	1950	22	15	6
1918	3	27	12	1951	2	14	4
1919	6	26	10	1952 LY	5	13	2

APPENDIX B — continued

Key Figures for Year of Birth

* LY indicates leap years.
** 1900 was not a leap year.
People born in a leap year between March and December must deduct 1 day from the value shown in each cycle.
For those born in a leap year between January 1 and February 29, the values shown in this chart remain as they are.

	23-Day Cycle	28-Day Cycle	33-Day Cycle
1953	7	11	32
1954	10	10	30
1955	13	9	28
1956 LY	16	8	26
1957	18	6	23
1958	21	5	21
1959	1	4	19
1960 LY	4	3	17
1961	6	1	14
1962	9	0	12
1963	12	27	10
1964 LY	15	26	8
1965	17	24	5
1966	20	23	3
1967	0	22	1
1968 LY	3	21	32
1969	5	19	29

	23-Day Cycle	28-Day Cycle	33-Day Cycle
1970	8	18	27
1970	8	18	27
1971	11	17	25
1972 LY	14	16	23
1973	16	14	20
1974	19	13	18
1975	22	12	16
1976 LY	2	11	14
1977	4	9	11
1978	7	8	9
1979	10	7	7
1980 LY	13	6	5
1981	15	4	2
1982	18	3	0
1983	21	2	31
1984 LY	1	1	29

APPENDIX C

Biorhythm Condition Testing Values
(Calculated as of the first of each month)

1952

Jan.	18	15	31
Feb.	3	18	29
Mar.	9	19	25
Apr.	17	22	23
May	1	24	20
June	9	27	18
July	16	1	15
Aug.	1	4	13
Sept.	9	7	11
Oct.	16	9	8
Nov.	1	12	6
Dec.	8	14	3

1953

Jan.	16	17	1
Feb.	1	20	32
Mar.	6	20	27
Apr.	14	23	25
May	21	25	22
June	6	0	20
July	13	2	17
Aug.	21	5	15
Sept.	6	8	13
Oct.	13	10	10
Nov.	21	13	8
Dec.	5	15	5

1954

Jan.	13	18	3
Feb.	21	21	1
Mar.	3	21	29
Apr.	11	24	27
May	18	26	24
June	3	1	22
July	10	3	19
Aug.	18	6	17
Sept.	3	9	15
Oct.	10	11	12
Nov.	18	14	10
Dec.	2	16	7

1955

Jan.	10	19	5
Feb.	18	22	3
Mar.	0	22	31
Apr.	8	25	29
May	15	27	26
June	0	2	24
July	7	4	21
Aug.	15	7	19
Sept.	0	10	17
Oct.	7	12	14
Nov.	15	15	12
Dec.	22	17	9

1956

Jan.	7	20	7
Feb.	15	23	5
Mar.	21	24	1
Apr.	6	27	32
May	13	1	29
June	21	4	27
July	5	6	24
Aug.	13	9	22
Sept.	21	12	20
Oct.	5	14	17
Nov.	13	17	15
Dec.	20	19	12

1957

Jan.	5	22	10
Feb.	13	25	8
Mar.	18	25	3
Apr.	3	0	1
May	10	2	31
June	18	5	29
July	2	7	26
Aug.	10	10	24
Sept.	18	13	22
Oct.	2	15	19
Nov.	10	18	17
Dec.	17	20	14

1958

Jan.	2	23	12
Feb.	10	26	10
Mar.	15	26	5
Apr.	0	1	3
May	7	3	0
June	15	6	31
July	22	8	28
Aug.	7	11	26
Sept.	15	14	24
Oct.	22	16	21
Nov.	7	19	19
Dec.	14	21	16

1959

Jan.	22	24	14
Feb.	7	27	12
Mar.	12	27	7
Apr.	20	2	5
May	4	4	2
June	12	7	0
July	19	9	30
Aug.	4	12	28
Sept.	12	15	26
Oct.	19	17	23
Nov.	4	20	21
Dec.	11	22	18

1960

Jan.	19	25	16
Feb.	4	0	14
Mar.	10	1	10
Apr.	18	4	8
May	2	6	5
June	10	9	3
July	17	11	0
Aug.	2	14	31
Sept.	10	17	29
Oct.	17	19	26
Nov.	2	22	24
Dec.	9	24	21

APPENDIX C — continued

Biorhythm Condition Testing Values
(Calculated as of the first of each month)

	1961				1962				1963		
Jan.	17	27	19	Jan.	14	0	21	Jan.	11	1	23
Feb.	2	2	17	Feb.	22	3	19	Feb.	19	4	21
Mar.	7	2	12	Mar.	4	3	14	Mar.	1	4	16
Apr.	15	5	10	Apr.	12	6	12	Apr.	9	7	14
May	22	7	7	May	19	8	9	May	16	9	11
June	7	10	5	June	4	11	7	June	1	12	9
July	14	12	2	July	11	13	4	July	8	14	6
Aug.	22	15	0	Aug.	19	16	2	Aug.	16	17	4
Sept.	7	18	31	Sept.	4	19	0	Sept.	1	20	2
Oct.	14	20	28	Oct.	11	21	30	Oct.	8	22	32
Nov.	22	23	26	Nov.	19	24	28	Nov.	16	25	30
Dec.	6	25	23	Dec.	3	26	25	Dec.	0	27	27

	1964				1965				1966		
Jan.	8	2	25	Jan.	6	4	28	Jan.	3	5	30
Feb.	16	5	23	Feb.	14	7	26	Feb.	11	8	28
Mar.	22	6	19	Mar.	19	7	21	Mar.	16	8	23
Apr.	7	9	17	Apr.	4	10	19	Apr.	1	11	21
May	14	11	14	May	11	12	16	May	8	13	18
June	22	14	12	June	19	15	14	June	16	16	16
July	6	16	9	July	3	17	11	July	0	18	13
Aug.	14	19	7	Aug.	11	20	9	Aug.	8	21	11
Sept.	22	22	5	Sept.	19	23	7	Sept.	16	24	9
Oct.	6	24	2	Oct.	3	25	4	Oct.	0	26	6
Nov.	14	27	0	Nov.	11	0	2	Nov.	8	1	4
Dec.	21	1	30	Dec.	18	2	32	Dec.	15	3	1

	1967				1968				1969		
Jan.	0	6	32	Jan.	20	7	1	Jan.	18	9	4
Feb.	8	9	30	Feb.	5	10	32	Feb.	3	12	2
Mar.	13	9	25	Mar.	11	11	28	Mar.	8	12	30
Apr.	21	12	23	Apr.	19	14	26	Apr.	16	15	28
May	5	14	20	May	3	16	23	May	0	17	25
June	13	17	18	June	11	19	21	June	8	20	23
July	20	19	15	July	18	21	18	July	15	22	20
Aug.	5	22	13	Aug.	3	24	16	Aug.	0	25	18
Sept.	13	25	11	Sept.	11	27	14	Sept.	8	0	16
Oct.	20	27	8	Oct.	18	1	11	Oct.	15	2	13
Nov.	5	2	6	Nov.	3	4	9	Nov.	0	5	11
Dec.	12	4	3	Dec.	10	6	6	Dec.	7	7	8

APPENDIX C — continued

Biorhythm Condition Testing Values
(Calculated as of the first of each month)

	1970				1971				1972		
Jan.	15	10	6	Jan.	12	11	8	Jan.	9	12	10
Feb.	0	13	4	Feb.	20	14	6	Feb.	17	15	8
Mar.	5	13	32	Mar.	2	14	1	Mar.	0	16	4
Apr.	13	16	30	Apr.	10	17	32	Apr.	8	19	2
May	20	18	27	May	17	19	29	May	15	21	32
June	5	21	25	June	2	22	27	June	0	24	30
July	12	23	22	July	9	24	24	July	7	26	27
Aug.	20	26	20	Aug.	17	27	22	Aug.	15	1	25
Sept.	5	1	18	Sept.	2	2	20	Sept.	0	4	23
Oct.	12	3	15	Oct.	9	4	17	Oct.	7	6	20
Nov.	20	6	13	Nov.	17	7	15	Nov.	15	9	18
Dec.	4	8	10	Dec.	1	9	12	Dec.	22	11	15

	1973				1974				1975		
Jan.	7	14	13	Jan.	4	15	15	Jan.	1	16	17
Feb.	15	17	11	Feb.	12	18	13	Feb.	9	19	15
Mar.	20	17	6	Mar.	17	18	8	Mar.	14	19	10
Apr.	5	20	4	Apr.	2	21	6	Apr.	22	22	8
May	12	22	1	May	9	23	3	May	6	24	5
June	20	25	32	June	17	26	1	June	14	27	3
July	4	27	29	July	1	0	31	July	21	1	0
Aug.	12	2	27	Aug.	9	3	29	Aug.	6	4	31
Sept.	20	5	25	Sept.	17	6	27	Sept.	14	7	29
Oct.	4	7	22	Oct.	1	8	24	Oct.	21	9	26
Nov.	12	10	20	Nov.	9	11	22	Nov.	6	12	24
Dec.	19	12	17	Dec.	16	13	19	Dec.	13	14	21

	1976				1977				1978		
Jan.	21	17	19	Jan.	19	19	22	Jan.	16	20	24
Feb.	6	20	17	Feb.	4	22	20	Feb.	1	23	22
Mar.	12	21	13	Mar.	9	22	15	Mar.	6	23	17
Apr.	20	24	11	Apr.	17	25	13	Apr.	14	26	15
May	4	26	8	May	1	27	10	May	21	0	12
June	12	1	6	June	9	2	8	June	6	3	10
July	19	3	3	July	16	4	5	July	13	5	7
Aug.	4	6	1	Aug.	1	7	3	Aug.	21	8	5
Sept.	12	9	32	Sept.	9	10	1	Sept.	6	11	3
Oct.	19	11	29	Oct.	16	12	31	Oct.	13	13	0
Nov.	4	14	27	Nov.	1	15	29	Nov.	21	16	31
Dec.	11	16	24	Dec.	8	17	26	Dec.	5	18	28

APPENDIX C — continued

Biorhythm Condition Testing Values
(Calculated as of the first of each month)

	1979				1980				1981		
Jan.	13	21	26	Jan.	10	22	28	Jan.	8	24	31
Feb.	21	24	24	Feb.	18	25	26	Feb.	16	27	29
Mar.	3	24	19	Mar.	1	26	22	Mar.	21	27	24
Apr.	11	27	17	Apr.	9	1	20	Apr.	6	2	22
May	18	1	14	May	16	3	17	May	13	4	19
June	3	4	12	June	1	6	15	June	21	7	17
July	10	6	9	July	8	8	12	July	5	9	14
Aug.	18	9	7	Aug.	16	11	10	Aug.	13	12	12
Sept.	3	12	5	Sept.	1	14	8	Sept.	21	15	10
Oct.	10	14	2	Oct.	8	16	5	Oct.	5	17	7
Nov.	18	17	0	Nov.	16	19	3	Nov.	13	20	5
Dec.	2	19	30	Dec.	0	21	0	Dec.	20	22	2

	1982				1983				1984		
Jan.	5	25	0	Jan.	2	26	2	Jan.	22	27	4
Feb.	13	0	31	Feb.	10	1	0	Feb.	7	2	2
Mar.	18	0	26	Mar.	15	1	28	Mar.	13	3	31
Apr.	3	3	24	Apr.	0	4	26	Apr.	21	6	29
May	10	5	21	May	7	6	23	May	5	8	26
June	18	8	19	June	15	9	21	June	13	11	24
July	2	10	16	July	22	11	18	July	20	13	21
Aug.	10	13	14	Aug.	7	14	16	Aug.	5	16	19
Sept.	18	16	12	Sept.	15	17	14	Sept.	13	19	17
Oct.	2	18	9	Oct.	22	19	11	Oct.	20	21	14
Nov.	10	21	7	Nov.	7	22	9	Nov.	5	24	12
Dec.	17	23	4	Dec.	14	24	6	Dec.	12	26	9

APPENDIX D

Biorhythm Calculation of the Injuried Football Players in 81 Season

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injureies
S-1	4-8-63	11-18-81	-	-	+	knee
S-2-1	5-5-62	10-4-81	+	+	+	hip
S-2-2	5-5-62	11-10-81	-	-	-	knee
S-3-1	9-18-61	8-31-81	-	+	-	shoulder
S-3-2	9-18-61	10-13-81	-	-	+	knee
S-4-1	5-8-61	10-18-81	-	-	+	trapezius
S-4-2	5-8-61	11-16-81	-	-	+	groin
S-5	1-18-61	10-11-81	+	+	+	quadriceps
S-6-1	4-16-61	9-18-81	+	+	+	ankle
S-6-2	4-16-61	10-18-81	-	+	-	ankle
S-7-1	5-11-62	8-31-81	-	-	-	eye
S-7-2	5-11-62	10-7-81	+	+	-	knee
S-7-3	5-11-62	10-11-81	+	+	-	ankle
S-8	4-15-63	8-24-81	C	C	+	ankle
S-9-1	8-5-63	8-24-81	-	+	-	lumber
S-9-2	8-5-63	10-11-81	-	+	+	hamstring
S-10	2-3-62	11-10-81	+	C	-	neck
S-11	7-12-62	8-25-81	-	+	-	toe
S-12	9-9-63	10-11-81	+	-	+	knee
S-13-1	8-5-61	9-22-81	-	-	-	arm

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
S-13-2	8-5-61	11-10-81	-	+	+	ankle
S-14	12-9-61	10-13-81	+	C	-	ankle
S-15	1-16-57	9-15-81	-	-	+	calf
S-16	5-17-62	10-6-81	-	-	-	concussion
S-17	4-20-62	8-28-81	+	+	+	eye
S-18	9-28-60	8-31-81	+	-	-	knee
S-19-1	6-11-59	8-28-81	-	-	-	concussion
S-19-2	6-11-59	11-2-81	-	+	-	ankle
S-20	9-18-63	10-25-81	-	+	+	ankle
S-21-1	7-6-63	10-7-81	-	+	+	ankle
S-21-2	7-6-63	8-26-81	+	-	-	groin
S-22-1	2-27-61	9-2-81	+	+	+	quadriceps
S-22-2	2-27-61	9-15-81	-	-	+	low back
S-23-1	4-21-61	10-7-81	+	-	-	hip
S-23-2	4-21-61	10-11-81	-	-	-	ankle
S-23-3	4-21-61	11-18-81	+	+	-	knee
S-24-1	4-22-61	8-24-81	+	+	+	foot
S-24-2	4-22-61	10-13-81	+	-	-	groin
S-24-3	4-22-61	11-10-81	-	-	-	neck
S-25-1	10-5-59	9-5-81	+	-	-	ankle

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
S-25-2	10-5-59	9-13-81	+	+	-	ribs
S-25-3	10-5-59	10-4-81	+	-	C	elbow
S-26-1	10-9-61	9-2-81	C	-	+	ankle
S-26-2	10-9-61	10-11-81	-	-	+	shoulder
S-27	3-25-64	8-29-81	-	+	-	foot
S-28	10-29-59	10-11-81	-	+	-	knee
S-29-1	2-7-60	8-24-81	+	C	C	knee
S-29-2	2-7-60	10-11-81	+	-	-	shoulder
S-29-3	2-7-60	9-5-81	-	C	-	toe
S-30-1	9-2-63	8-31-81	-	-	+	ankle
S-30-2	9-2-63	11-10-81	-	+	+	knee
S-31	4-28-63	11-2-81	+	-	-	quadriceps
S-32	3-16-60	9-22-81	-	-	+	knee
S-33	4-20-61	9-27-81	-	-	+	hip
S-34	6-14-64	10-18-81	+	+	-	quadriceps
S-35-1	11-28-62	8-31-81	-	-	-	ankle
S-35-2	11-28-62	11-4-81	-	C	-	knee
S-35-3	11-28-62	9-9-81	+	C	-	hamstring
S-35-4	11-28-62	9-22-81	-	+	+	metacarpal
S-36	6-4-61	8-24-81	+	-	-	knee

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
S-37	5-12-60	4-6-81	-	-	+	ankle
S-38	7-12-62	4-6-81	-	+	+	metatarsal
S-39	12-20-60	4-7-81	+	-	-	shoulder
S-40	10-19-59	4-7-81	-	+	-	knee
S-41	8-25-63	4-8-81	-	-	+	ankle
S-42	5-10-61	4-8-81	+	-	+	hamstring
S-43	4-20-62	4-9-81	+	+	-	foot
S-44	2-6-62	4-10-81	C	+	+	neck
S-45	8-25-63	4-10-81	-	-	+	ankle
S-46	5-13-62	4-13-81	+	-	+	ankle
S-47	12-9-61	4-13-81	+	+	+	ankle
S-48	1-15-61	4-14-81	C	+	+	ankle
S-49	4-20-62	4-15-81	-	-	+	metatarsal
S-50	2-7-60	4-21-81	-	-	-	knee
S-51	4-21-61	4-21-81	-	-	+	knee
S-52	4-20-62	4-21-81	-	-	+	metacarpal
S-53	2-3-62	4-21-81	-	-	-	low back
S-54	7-19-61	4-29-81	+	+	-	groin
S-55	4-16-61	4-29-81	+	+	-	knee
S-56	5-10-61	4-29-81	+	C	+	hand
S-57	3-5-60	5-9-81	C	+	C	knee
S-58	6-14-59	5-9-81	+	-	+	shoulder

APPENDIX E

Biorhythm Calculation of the Injuried Football Players in 82 Season

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-1	4-18-63	8-29-82	-	-	+	hamstring
N-2-1	10-19-59	4-5-82	-	C	-	knee
N-2-2	10-19-59	4-21-82	+	-	+	neck
N-2-3	10-19-59	11-7-82	+	-	+	eye
N-2-4	10-19-59	10-24-82	C	+	-	hand
N-2-5	10-19-59	9-1-82	+	+	+	concussion
N-3-1	5-5-62	8-31-82	-	+	-	hip pointer
N-3-2	5-5-62	10-12-82	-	-	+	pattella
N-4-1	9-18-61	4-27-82	+	-	+	low back
N-4-2	9-18-61	9-12-82	+	-	+	quadriceps
N-4-3	9-18-61	11-31-82	-	-	-	finger
N-5-1	11-7-62	4-15-82	-	+	+	low back
N-6-1	8-5-62	8-27-82	-	-	+	hamstring
N-6-2	8-5-62	9-22-82	+	-	-	foot
N-7	2-10-62	10-3-82	+	+	+	hip
N-8-1	1-18-61	4-29-82	-	-	C	low back
N-8-2	1-18-61	10-24-82	-	-	-	hand
N-9-1	2-26-61	8-19-82	+	+	-	leg
N-9-2	2-26-61	9-6-82	-	-	-	achilles tendonitis
N-10	4-16-61	4-27-82	+	+	-	knee

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-11-1	5-11-62	4-15-82	C	-	-	ankle
N-11-2	5-11-62	4-23-82	-	+	-	knee
N-11-3	5-11-62	9-26-82	-	-	-	knee
N-12-1	4-15-63	8-31-82	-	-	C	low back
N-12-2	4-15-63	9-7-82	+	+	-	metacarpal
N-12-3	4-15-63	10-17-82	-	+	-	ankle
N-13-1	8-5-63	9-2-83	-	-	+	shoulder
N-13-2	8-5-63	10-24-82	+	-	-	finger
N-14	12-22-62	9-28-82	-	-	-	knee
N-15	11-8-64	8-25-82	-	+	-	quadriceps
N-16	2-27-64	9-3-82	C	C	-	groin
N-17	4-20-62	4-29-82	C	+	+	shoulder
N-18	1-11-63	8-22-82	+	-	+	knee
N-19	12-28-61	11-7-82	-	+	-	scapula
N-20	6-11-59	8-29-82	-	-	C	wrist
N-21-1	12-6-58	9-26-82	+	-	C	ribs
N-21-2	12-6-58	10-10-82	-	+	-	knee
N-22-1	2-7-61	4-8-82	+	+	-	ankle
N-22-2	2-7-61	4-13-82	+	-	-	hamstring
N-22-3	2-7-61	9-4-82	-	-	+	thumb sprain

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-23-1	4-21-61	4-21-82	C	-	+	foot
N-23-2	4-21-61	9-26-82	+	-	+	ankle
N-23-3	4-21-61	10-19-82	+	+	C	shoulder
N-24-1	4-22-61	4-5-82	-	+	-	knee
N-24-2	4-22-61	8-29-82	+	-	+	groin
N-24-3	4-22-61	9-7-82	C	-	-	ankle
N-24-4	4-22-61	10-24-82	-	-	+	shoulder
N-25-1	6-28-60	4-20-82	+	C	+	knee
N-25-2	6-28-60	11-1-82	-	+	+	hamstring
N-26	12-27-62	10-19-82	-	+	+	knee
N-27-1	11-29-63	8-27-82	-	C	+	sternum
N-27-2	11-29-63	9-7-82	+	-	-	knee
N-27-3	11-29-63	9-14-82	+	+	C	shoulder
N-27-4	11-29-63	9-29-82	+	-	C	knee
N-27-5	11-29-63	11-31-82	-	-	-	back
N-28	12-24-63	9-3-82	-	-	-	shoulder
N-29	12-5-61	4-1-82	-	+	-	knee
N-30-1	7-12-62	4-23-82	+	+	-	hip
N-30-2	7-12-62	10-20-82	-	+	+	hand
N-30-3	7-12-62	10-21-82	+	-	+	knee

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-31	12-20-60	4-21-82	-	+	+	shoulder
N-32	5-28-62	4-23-82	+	-	+	knee
N-33-1	9-22-62	11-15-82	C	-	C	hamstring
N-33-2	9-22-62	4-5-82	+	-	+	achilles tendon
N-33-3	9-22-62	4-15-82	-	+	C	shoulder
N-34	9-9-63	4-5-82	-	+	-	knee
N-35	12-3-62	11-15-82	-	+	-	foot
N-36	12-11-63	11-7-82	+	-	+	forearm
N-37-1	9-7-63	4-23-82	+	+	+	hand
N-37-2	9-7-63	9-2-82	C	-	+	knee
N-38	4-12-61	4-9-82	+	-	+	shoulder
N-39-1	7-19-63	4-13-82	-	+	+	calf
N-39-2	7-19-63	8-29-82	-	+	-	quadriceps
N-39-3	7-19-63	11-31-82	-	-	+	hand
N-40	8-10-64	10-17-82	-	+	+	ankle
N-41	2-16-62	4-23-82	C	+	+	ankle
N-42-1	5-12-60	8-22-82	-	-	-	toe
N-42-2	5-12-60	10-24-82	-	-	C	shoulder
N-42-3	5-12-60	11-7-82	-	+	-	hamstring
N-43	7-9-64	9-6-82	+	+	C	knee

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-44-1	8-5-61	4-29-82	+	+	+	sternum
N-44-2	8-5-61	9-6-82	-	+	+	calf
N-44-3	8-5-61	11-7-82	-	+	+	arms
N-45	12-9-61	4-13-82	+	+	+	hamstring
N-46	1-16-57	4-15-82	-	+	+	ankle
N-47-1	10-5-59	8-31-82	C	-	-	ankle
N-47-2	10-5-59	9-26-82	-	-	+	knee
N-48-1	7-15-63	4-13-82	-	-	C	ankle
N-48-2	7-15-63	4-20-82	+	-	-	hip
N-49	10-9-61	8-31-82	-	-	+	hip pointer
N-50	3-25-64	4-1-82	+	+	+	foot
N-51-1	12-13-63	8-27-82	-	+	+	shoulder
N-51-2	12-13-63	10-5-82	-	+	+	back
N-52	8-6-61	4-24-82	C	+	+	groin
N-53	12-7-60	9-20-82	C	+	+	ankle
N-54	3-5-60	10-24-82	C	+	-	hamstring
N-55	10-29-59	10-24-82	+	-	+	shoulder
N-56-1	1-15-61	4-24-82	-	C	+	hamstring
N-56-2	1-15-61	4-27-82	-	-	-	forearm
N-56-3	1-15-61	11-21-82	-	+	-	shoulder

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-57-1	2-7-60	9-3-82	+	+	-	ribs
N-57-2	2-7-60	9-12-82	-	-	+	calf
N-57-3	2-7-60	10-11-82	+	-	-	hamstring
N-58-1	9-2-63	4-8-82	+	-	-	ankle
N-58-2	9-2-63	9-3-82	C	+	C	knee
N-59-1	4-28-63	4-14-82	+	+	-	ribs
N-59-2	4-28-63	8-23-82	-	+	-	low back
N-59-3	4-28-63	9-19-82	C	C	-	ankle
N-60-1	3-16-60	4-27-82	+	+	-	knee
N-60-2	3-16-60	8-24-82	+	-	+	hip
N-60-3	3-16-60	8-29-82	-	-	-	knee
N-60-4	3-16-60	10-10-82	+	+	-	hip
N-61	7-7-63	8-19-82	-	+	-	groin
N-62	4-20-61	9-3-82	+	-	-	hip
N-63	1-27-61	9-3-82	+	-	C	elbow
N-64-1	7-19-61	8-19-82	+	+	-	hand
N-64-2	7-19-61	9-12-82	-	-	+	shoulder
N-64-3	7-19-61	9-26-82	C	+	-	knee
N-65-1	5-10-61	11-31-82	+	+	-	knee
N-65-2	5-10-61	9-7-82	-	-	+	knee

Subj. No.	Birth Date	Injury Date	Phy.	Em.	Int.	Type of Injuries
N-65-3	5-10-61	9-14-82	C	-	+	thumb
N-66-1	11-28-62	4-13-82	-	-	+	knee
N-66-2	11-28-62	4-29-82	+	+	-	shoulder
N-66-3	11-28-62	8-22-82	+	+	+	knee
N-66-4	11-28-62	10-3-82	+	-	-	ankle
N-67-1	6-4-61	8-24-82	C	-	-	knee
N-67-2	6-4-61	10-11-82	+	-	+	hip