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RELATIONSHIP BETWEEN FITNESS LEVEL OF FEMALE BASKETBALL COACHES AND THEIR CARDIAC RESPONSE DURING GAME SITUATIONS

By

Jerry N. Rickrode

An Abstract

of a thesis submitted in partial fulfillment

of the requirements for the degree of

Master of Science in the School

of Health, Physical Education,

and Recreation at

Ithaca College

September 1987

Thesis Advisor: Dr. G. A. Sforzo

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ABSTRACT

This study investigated the relationship between fitness level of female basketball coaches and their cardiac response during game situations. In addition, the relationship between ranking of critical incidents by expert basketball coaches and cardiac response by subjects during critical incidents was studied. The five subjects were the head coaches of Cornell University, Cortland State University, Ithaca College, Syracuse University, and William Smith College women's basketball teams. The cycle ergometer (Jaegar Ergotest, ER 40) was used to assess fitness level through a submaximal exercise test, and the Holter monitor (Space Labs 7200, 6201 D3) was used to gather data in the form of electrocardiographic records throughout the course of a basketball game. A high correlation was established between fitness level and average HR throughout an entire game. Significant Pearson product-moment correlations ($p < .05$) were found between fitness level and mean HR at three of the critical incidents and high, almost significant Pearson product-moment correlations were found during four other critical incidents. These results tend to support the idea that fitness level may play an integral role in the cardiac response of female basketball coaches during game situations. Additionally, Spearman rank-order correlation between the grand mean HR response and the expert ranking of critical incidents revealed a negligible correlation. Due

to this finding, there is little reason to support the idea that there is a significant relationship between the ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents.

RELATIONSHIP BETWEEN FITNESS LEVEL OF FEMALE BASKETBALL COACHES AND THEIR CARDIAC RESPONSE DURING GAME SITUATIONS

A Thesis Presented to the Faculty of
the School of Health, Physical
Education, and Recreation at
Ithaca College

In Partial Fulfillment of the
Requirements for the Degree
Master of Science

---

by

Jerry N. Rickrode

September 1987

Ithaca College
School of Health, Physical Education, and Recreation
Ithaca, New York

CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the Master of Science Thesis of

Jerry N. Rickrode

submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Health, Physical Education, and Recreation at Ithaca College has been approved.

Thesis Advisor:

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Chairman, Graduate Programs in Physical Education:

Dean of Graduate Studies:

Date: 8/13/87

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Chapter 1

INTRODUCTION

An athlete's cardiovascular system must be well conditioned through rigorous aerobic and anaerobic training to meet the imposing demands of athletic competition. Physical training prior to the season not only enhances athletic performance but also lowers the risk of cardiovascular illness in athletes (Conti & McClintock, 1983; Porter & Allsen, 1978). But, what about the person coaching the game? The frustration or jubilation of watching execution of plays, the depression of losing a game, or the elation of winning; do these disparate emotional situations cause a coach's HR to vary? The stress involved with coaching competitive sports may cause a coach's heart rate (HR) to greatly increase, but does this HR increase present a challenge to the coach's cardiovascular system?

The pressure to win that is exerted on coaches by themselves, peers, and employers, coupled with long working hours, often results in high anxiety, which may contribute to the development of coronary heart disease. Each season a number of coaches suffer heart attacks while fulfilling their coaching responsibilities (Porter & Allsen, 1978). For examples, Ken Long, a South Carolina high school basketball coach, died of a heart attack moments after his team posted a one-point victory and Bill Foster, head men's basketball coach at the University of South Carolina, suffered a heart attack during a game. In addition, National Basketball Association coaches Hubie Brown and Chuck Daly both have experienced anginal pain during games (Duda, 1984).

Past studies portray convincing data that showed HR increases in athletes due to anticipation of competition as well as during competition (Gazes, Sovell, & Dellastatious, 1982; Porter & Allsen, 1978). However, there have been relatively few studies which examined cardiovascular response of coaches to athletic events in which they are performing their duties (Gazes et al., 1982; Husman, Hansen, & Walker, 1970; Porter & Allsen, 1978). The induced psychological stress of game situations may cause a coach's HR to greatly increase. It has been reported that individuals who possess a high level of aerobic endurance evince smaller increases in arousal to psychologically stressful situations (Holmes & Roth, 1985). It is of interest to assess whether or not aerobic fitness helps to mitigate the stress response associated with coaching. Therefore, the purpose of this study was to assess the relationship between fitness levels of basketball coaches with their cardiac response during game situations.

Statement of Problem

The purpose of this study was to investigate the relationship between fitness level of female basketball coaches and their cardiac response during game situations.

Scope of Problem

An attempt was made to find out if there is any relationship between fitness level of female varsity college basketball coaches and cardiac response during game situations. For this purpose, Holter monitoring was employed in order to gather ECG information with monitoring performed continuously throughout the course of selected contests. However, only ECG records of selected critical times were used in the data analysis. Examples of critical times included: jump ball at the game's commencement, time out after opposing team gathers momentum, and coach-referee confrontations. These critical incidents were not held constant during each game but varied from game to game. A running account of critical incidents was recorded throughout the course of each game.

Cardiac monitoring was also performed during a submaximal cycle ergometry test. The subjects' fitness levels were determined by their HR attained at a particular submaximal work load. This allowed the investigator to compare fitness level with the HR response observed during the critical incidents of a basketball game. In addition, pulse rate monitoring was performed during the day under resting laboratory conditions to establish a baseline HR for the participants.

Hypothesis of Study

The following null hypotheses concerning the relationship of fitness level to cardiac response in female varsity college basketball coaches during game situations were identified:

H_0: There will be no significant relationship between the coaches' fitness level and cardiac response during a basketball game.

H_0: There will be no significant relationship between the ranking of critical incidents by expert basketball coaches and cardiac response by subjects during critical incidents.

Definition of Terms

The following terms that were used in this study are herein defined:

1. Critical Incidents: The happenings in a basketball game that could have a potential impact on the game's outcome, and may cause induced excitement in the coach.

2. Fitness Level: The HR attained by the subjects while pedaling at a standard submaximal work load on a cycle ergometer.

3. Psychological Stress: The hardship or oppression associated with coaching basketball during a game situation.

Assumptions of Study

The following assumptions concerning the study were made:

1. Subjects answered the medical history questionnaire honestly.

2. Subjects were not psychologically stressed during monitoring of baseline HR.

3. Subjects did not change their regular consumption of caffeine, nicotine, and medication throughout the entire course of the study.

4. Subjects did not change their exercise habits throughout the entire course of the study.

5. True fitness level was predicted through the submaximal heart rate at the given work load.

6. Subjects had no arrhythmia presence prior to monitoring that were unspecified on the medical history questionnaire.

Delimitations of Study

The following were the delimitations of the study:

1. Only five female varsity college basketball coaches were tested.

2. Only Holter monitoring was used to gather electrocardiographic records.

3. The HR attained at the third stage during the second min of a cycle ergometer exercise test protocol (workload = 150 watts) was the only measure of fitness level used.

4. The only data used to measure emotional arousal was average HR throughout the game and average HR during the critical incidents.

Limitations of Study

The following limitations were made for this study:

1. Results of this study can be inferred only to female varsity college basketball coaches.

2. Results of this study apply only when HR data gathered during a submaximal cycle ergometry test is used to determine fitness level.

3. Results of this study apply only when average HR throughout the game and average HR during the critical incidents are used to measure emotional arousal.

4. A limitation is placed upon the statistical power of this study due to the small N.

Chapter 2

REVIEW OF LITERATURE

Most studies on cardiac response during athletics have dealt with heart rate fluctuation and arrhythmia occurrence in participants during anticipation or throughout the contests. There have been relatively few studies conducted on coaches' cardiac response during stressful game situations. Unfortunately, there have been coaches who have died or suffered cardiac arrest while coaching. It has been suggested by Duda (1984) that every coach should have a very detailed cardiovascular evaluation at least once a year and participate in an aerobic type exercising program throughout the season. Does the psychological stress experienced by a coach throughout the season and particularly during game situations present a cardiovascular challenge? Does fitness level play a part in the degree to which psychological stress affects coaches' cardiac response? If so, then perhaps coaches should prepare to meet the challenge of their stressors with exercise training as suggested by Duda.

This chapter will review the literature pertinent to this study. Specifically, this chapter will include the following sections: (a) physical fitness and emotional stress, (b) sports-related cardiac response, (c) cardiac response of basketball coaches, and (d) summary.

Physical Fitness and Emotional Stress

It has been reported that individuals with a high level of aerobic fitness evince smaller increases in arousal to psychologically stressful situations than individuals with a low level of aerobic fitness (Holmes & Roth, 1985). A smaller HR response to psychological stress might be expected in individuals with high aerobic fitness because they possess the capacity for larger increases in stroke volume and smaller increases in HR during physical work/stress (Astrand & Rodahl, 1977). Holmes and Roth also stated that, despite the current interest in fitness and its potential benefits, the published research on the relationship between fitness and cardiovascular response to psychological stress is limited.

There have been a few investigations that have examined the relationship between aerobic fitness level with heart rate recovery from stress. Jamieson, Evans, and Cox (1982) studied the effects of aerobic power on stress reactivity. The psychosocial stressor used in the study significantly elevated heart rate for all groups, but there was no relationship between fitness level and HR. However, the highly fit subjects had more completely recovered from stress at the end of a 5-min recovery period. This finding was supported by Keller and Seraganian (1984). They performed two experiments dealing with the influence of aerobic fitness level on autonomic reactivity to psychosocial stress. In the first experiment, 45 men were placed into three groups according to their fitness level.

The three groups were labeled physically trained, untrained, and training currently. Members of the physically trained group were longstanding and continuing participants of an advanced fitness program at the YMCA. Members of the untrained group consisted of men who were not currently engaged in any form of physical activity. And members of the training currently group had just begun fitness classes at the YMCA. The subjects' autonomic reactivity was measured by their lability in electrodermal activity during two speeded mental tasks designed to induce psychosocial stress. Over the course of the study, subjects in the currently training and physically trained groups showed faster recovery in the electrodermal response. In the second experiment, they used 60 male and female subjects of mixed fitness level. Two psychosocial stressors selected from a battery of six were counterbalanced among the subjects. Again, subjects with high fitness levels displayed faster recovery to the psychosocial stressors. They concluded that the quicker autonomic recovery may allow the aerobically fit to cope more effectively with emotional stress.

Sinyor, Schwartz, Peronnet, Brisson, and Seraganian (1983) measured HR recovery in 15 highly trained and 15 untrained subjects at various points before, during, and after exposure to a series of psychosocial stressors. They found that HR increased substantially in both groups during the stressor. But, they also discovered that the aerobically trained subjects possessed a much more rapid heart rate recovery following the stressors than did the untrained individuals.

There has been one study that exhibits results that are contradictory to studies by Keller and Seraganian (1984) and Jamieson et al. (1982). Zimmerman and Fulton (1979) used 20 aerobically fit and 20 unfit subjects in their study of aerobic fitness and emotional arousal. They reported that there was no difference in HR recovery between the two groups after subjection to a moderately stressful situation. They concluded that, within the context of the moderately stressful situation, the extent to which subjects were aerobically fit made no difference in speed of HR recovery. In summary, there are controversial findings exhibited by the literature dealing with fitness level and HR recovery to psychosocial stress.

There have been four investigations that have shown lower pulse rate response by high fit subjects to psychosocial stress (Cantor, Zillman, & Day, 1978; Holmes & Roth, 1985; Hull, Young, & Ziegler, 1984; Light, Obrist, & James, 1984). Cantor et al. (1978) used 72 male and female subjects and introduced an arousing film segment to each. Subjects who had a low level of fitness had a significantly greater elevation in HR and blood pressure in response to the films. They concluded that cardiorespiratory fitness influences individuals' physiological responses to emotional states that do not involve any physical activity.

The association of aerobic fitness with pulse rate in response to psychological stress in 10 high fit and 10 low fit subjects was examined by Holmes and Roth (1984). The subjects participated in a mildly stressful task composed of recalling digits backwards. High fit subjects evinced a smaller pulse rate increase in response to the task. In fact, low fit subjects displayed pulse rates that were as much as 19 beats per minute (bpm) greater than those of the high fitness group. Holmes and Roth concluded that aerobic fitness influences individuals cardiovascular response to performance of stressful tasks.

Hull et al. (1984) tested the effects of aerobic fitness on cardiovascular and catecholamine responses to stressors. The 60 male and female subjects were introduced to four stressors in succession. Viewing a film depicting industrial accidents, performing a word color task with conflicting auditory stimuli, placing a foot in ice water, and exercising on an automated treadmill until exhaustion were the four stressors employed. The aerobically fit subjects over 40 years of age exhibited lower diastolic blood pressure response to stressors. Interestingly, they found marked bradycardia in fit persons both at rest and in response to stressors.

Light et al. (1984) used self-reported exercise levels for 174 male subjects in studying the relationship between physical fitness and cardiovascular responses to stress.

The stressors used were in the form of a 2-min foot immersion cold pressor test and a 4-min reaction time challenge presented as a shock avoidance task. The high exercise group showed lower HR and blood pressure responses during the administering of the stressors. The literature has shown that subjects who have high fitness levels yield lower pulse rate response to psychological stressors.

There have also been a few investigations that have shown no significant difference in HR response to stress between high and low fit subjects (Cox, Evans, & Jamieson, 1979; Sinyor et al., 1982). Cox et al. (1979) studied the HR responses to psychosocial stress in diversely trained subjects. Their results showed an absence of a difference in HR between low and high fit subjects during the experimental stress period. Sinyor et al. (1983) supported these findings in their study of aerobic fitness level and reactivity to psychosocial stress. They found that, during stressors, subjects in the highly trained group and subjects in the untrained group exhibited indistinguishable increases in HR. In summary, the literature has shown controversial results in investigations dealing with fitness level and HR response to psychosocial stressors.

<u>Sports-Related Cardiac Response</u>

There have been studies performed on referees, race car drivers, speed boat racers, and coaches to examine how psychological stress will precipitate a change in cardiac response (Conte & McClintock, 1983; Gait, Cook, Allen, & Duncan, 1984; Holland, 1979; Johnson, 1980; McCafferty, Gliner, & Horvath, 1978). Conte and McClintock (1983) monitored a head referee during a football game and found the lowest HR recorded during the game to be 140 bpm. This value was 137% above his resting heart rate. The highest HR recorded was 160 bpm and the referee's HR was close to 140 bpm when he met the captains at midfield prior to the start of the game. Because officiating is largely anaerobic, Conti and McClintock concluded that the sustained tachycardia was probably caused by psychological stress.

The intense psychological stress involved in basketball officiating was studied by Holland (1979). In addition to recording changes in cardiac response of officials throughout the course of the game, Holland looked at the possibility of a difference in cardiac response when officiating regular season games as compared to state tournament games. He found that officials' HR increased to at least 75% of maximum while officiating regular season games. Additionally, he reported higher HR were associated with refereeing state tournament games.

Gait et al. (1984) found that the HR of volleyball officials increased greatly during game conditions. Because the officials moved very little throughout the course of the game, Gait et al. attributed the increase in HR to psychological stress.

Johnson (1980) performed a study on speed boat racers to see if their HR would increase simply due to the mental pressure inflictd upon them during competition, because little physical exertion is required during boat racing. Through continuous Holter monitoring, Johnson found that each of his six subjects showed a great increase in HR during the race. One of the subjects achieved a HR of 183 bpm when merely pushing the starting button on his boat at the begining of the race. Two of the subjects exhibited HR of 129 bpm and 150 bpm while waiting on shore for the 5-min gun to be shot before the race. Johnson concluded that the mental pressure alone inflicted on athletes during competition may cause substantial increase in heart rate. McCafferty et al. (1978) conducted a study to see if the stress on coaches of "minor" sports, such as swimming, water polo, and cross country, causes an increase in HR response similar to coaches of major sports like basketball and football. They found that the HR changes of these coaches indicated that there was a considerable amount of stress inflicted upon them while coaching. There was an increase in HR of 21 bpm in the cross country coach when his runners were in view. The water polo coach exhibited a mean HR of 90 bpm during a preseason alumni game. The swimming coach showed a 51 bpm increase over baseline rate as an average during a meet. At one point, the swimming coach's HR reached 161 bpm. McCafferty et al. concluded that the source of stress was the coaches' perceptions of the contests and the meanings of the outcomes.

Cardiác Responses of Basketball Coaches

Over one million people in the United States suffer heart attacks every year. Poor health habits, high work load, insufficient exercise, and emotional stress have been the key factors in inducing a great amount of these heart attacks. Included in the statistics of middle aged deaths resulting from coronary heart disease have been a number of coaches who suffered heart attacks while fulfilling coaching responsibilities (Porter & Allsen, 1978). On January 3, 1984, Ken Long, a 40-year-old South Carolina high school basketball coach, died of a heart attack moments after his team posted a one-point victory (Duda, 1984). Duda also stated that National Basketball Association coaches Hubie Brown of the New York Knicks and Chuck Daly of the Detroit Pistons experienced anginal pain during the 1983 preseason. Midway through the 1983 college basketball season, Bill Foster, head men's basketball coach at the University of South Carolina, suffered a heart attack during a game against Purdue. Four days later he underwent quadruple bypass surgery. Foster reported that he was not exercising properly and that he had not had a thorough examination of his cardiovascular system for some length of time prior to his heart attack.

Basketball is perhaps one of the more stressfull sports to coach because of the quick changes of score and the number of turnovers involved in the game (Duda, 1984). Duda asserted that coaches, when compared to players, are at an increased risk of developing cardiac problems because they do not have a physical outlet during the game.

There have only been a few studies conducted on the cardiac responses of basketball coaches during the stress of game situations (Gazes et al., 1978; Husman et al., 1970; Porter & Allsen, 1978; Reusser & Edwards, 1986). Gazes et al. (1978) monitored 30 football and basketball coaches continuously through the course of their games. Pregame HR of less than 100 bpm were observed in only three of the coaches. The others had pregame HR of between 100 and 150 bpm. The maximum HR observed was 188 bpm at one point in a game. The same coach's average HR was 166 bpm. Strangely enough, major game events, such as touchdowns, pass interceptions, missed baskets, and time outs, caused no significant increase in HR.

Porter and Allsen (1978) measured the HR of basketball coaches during game situations. They found that one of the coaches exhibited a 135 bpm average HR throughout the entire contest. The highest HR monitored was 162 bpm. This value was 253% above the resting HR of the coach. The mean percentage elevation above baseline HR for their subject group was 99.6. One coach showed a 120 bpm HR 5 min prior to the beginning of the game. When the same coach was monitored a second time, his team was undefeated. Although his team was playing the same team they did the first time he was monitored, the coach only displayed a 96 bpm HR 5 min prior to the game. During the fourth quarter when the game was close, the coach's HR was 142 bpm.

Husman et al. (1970) analyzed the pulse rate of a high school varsity basketball coach. They found that the coach's HR averaged 113 bpm during the first 8 min of the game. From then until the end of the game his average HR was 135 bpm. His HR increased to 150 bpm when an opposing player was shooting a free throw.

Reusser and Edwards (1986) conducted a study on a women's basketball coach and found that her HR peaked at 140 bpm during a game. Her HR was 52 under office conditions. They concluded that the psychological stress inflicted on a coach during a game may cause the heart to function at a greatly increased rate. The literature has shown that coaches' heart rates are substantially increased prior to and throughout the course of a basketball game.

<u>Summary</u>

It has been demonstrated in this chapter that the occupation of coaching can be very stressful, as illustrated by heart rate response of coaches during athletic events. The literature has also displayed that aerobic fitness level may have a bearing on a person's response to psychological stress. Coaches may help protect themselves against cardiovascular disease by participating in an aerobic fitness program. There have only been a few studies dealing with cardiac response of coaches during game situations, and research has not provided conclusive answers about the relationship between fitness level and cardiac response.

Chapter 3

METHODS AND PROCEDURES

The methods used in this study are explained in this chapter. It includes the following sections: (a) selection of subjects, (b) methods of data collection, (c) treatment of data, and (d) summary.

Selection of Subjects

The participants consisted of five female head varsity college basketball coaches. The five participants were the head coaches of Cornell University, Cortland State University, Ithaca College, Syracuse University, and William Smith College women's basketball teams. These participants were recruited by the investigator through personal contact. Prior to any data collection, all five subjects signed an informed consent form that explained the purpose and methods of the study (see Appendix A).

Methods of Data Collection

The informed consent form was presented to each subject by the investigator on the day of the monitored game. During the month of February, 1987 each subject was monitored throughout the course of one basketball game. A Holter monitor (Space Labs 7200, 6201 D3) was used to gather data in the form of electrocardiographic records. A Holter monitor was placed on each subject 1 to 2 hr prior to the commencement of each game. A female assistant was responsible for proper placement of electrodes on the subjects (Space Labs, 1985). At the exact onset of the Holter monitoring a stop watch was started, enabling the investigator to keep time that was synchronized with the time clock of the Holter monitor. During the basketball game, the investigator recorded the time and occurrence of critical incidents. During the month of April, 1987 each subject reported once to the exercise physiology laboratory at Ithaca College. Upon arrival at the laboratory, a medical history questionnaire (see Appendix B) and an informed consent form for an exercise test (see Appendix C) was completed by each subject and baseline HR was measured. The baseline HR were HR under resting laboratory conditions. Each subject then performed a submaximal exercise test on a cycle ergometer (Jaeger Ergotest, ER 40). The subjects pedaled at three submaximal workloads of 50, 100, and 150 watts. In addition, a brief warm-up period using a 25-watt workload preceded the test, and an active recovery followed. HR were recorded using a single channel electrocardiogram (Medical Systems Coorporation 7111) during the last 15 sec of each min of each stage of the submaximal test.

In addition, a card on which eight critical incidents were listed (see Appendix D) was presented to five expert veteran basketball coaches. The five experts ranked the critical incidents according to the amount of induced excitement thought to be associated with each. The incident ranked eight was associated with the most induced excitement according to the experts. The incident ranked one was associated with the least excitement according to the experts. The rankings of each critical incident from the five expert veteran basketball coaches were summed and ordered from most to least excitement inducing. This final rank order of the critical incidents was later used in the analysis.

Treatment of Data

The analysis of data in this study encompassed descriptive statistics, Pearson product-moment correlations, and a Spearman rank-order correlation. Elevation of HR beyond baseline rate for each subject during critical incidents and throughout the entire game was calculated and tabulated.

The relationship between the fitness level of female basketball coaches and their cardiac response during game situations was investigated. Fitness level was estimated by using the HR attained at the third stage during the 2nd min of the submaximal cycle ergometer test. The subjects were pedaling at a workload of 150 watts at this time. It was assumed that better fitness level was associated with lower HR during submaximal exercise. The average HR throughout the entire game was then computed for each coach. Pearson product-moment correlation tested the relationship between fitness level and average cardiac response during a game.

To study the effect of fitness level on HR response at each of the eight critical incidents, eight Pearson product-moment correlations were run and tabulated. This was done by averaging the HR responses during the eight critical incidents, of which there were many repeats, and correlating these with the submaximal cycle exercise HR responses.

Additionally, the relationship between the ranked critical incidents, as done by five expert veteran basketball coaches, and subjects' average HR during each of these critical incident categories was examined by Spearman rank-order correlation.

Summary

The methods of this study were detailed in this chapter including the selection of subjects, methods of data collection, and treatment of data. It was through these methods that the relationship between fitness level of female basketball coaches and their cardiac response during game situations was investigated. The relationship between ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents of a basketball game was also studied.

Chapter 4

ANALYSIS OF DATA

This study was conducted to investigate the relationship between the fitness level of female basketball coaches and their cardiac response during game situations. The amount of excitement induced during critical incidents in a basketball game was also examined. This was done by looking at the relationship between ranking of the critical incidents by five expert veteran basketball coaches and cardiovascular response of the subjects. Sections in this chapter include the following: (a) descriptive statistics, (b) correlation of fitness level and cardiac response, (c) correlation of incident ranking and cardiac response, and (d) summary.

Descriptive Statistics

The five subjects who participated in the study varied in age from 30-37. The mean age of the entire group was 32.8 $\pm$ 2.8 years.

The amount of excitement induced during game situations was examined through calculation of percent elevation of HR above baseline values for each subject. Table 1 presents each subject's mean percent elevation of HR above baseline values for an entire game. It can be seen that each subject's baseline HR was elevated during the game.

Table 2 presents HR elevation above baseline values during the critical incidents of the game. Two of the

Table 1

Heart Rate Characteristics of Subjects

Coach	Resting HR	Average Game HR	Above Baseline (%)
A	68	115	69
B	94	118	25
C	56	88	57
D	52	86	65
E	64	84	31

Table 2

Heart Rate Elevation During Critical Incidents

Incident[a]	Coach A	Coach B	Coach C	Coach D	Coach E
YP	76 (1)	37 (5)	36 (1)	54 (3)	30 (1)
RB	84 (3)	20 (6)	61 (3)	56 (5)	41 (3)
GP	76 (2)	37 (3)	57 (2)	54 (4)	52 (4)
OJ	71 (1)	15 (1)	79 (1)	69 (1)	44 (1)
ML	47 (2)	45 (2)	36 (1)	69 (1)	--
TO	76 (3)	20 (2)	61 (4)	54 (2)	38 (1)
PE	82 (2)	19 (3)	50 (2)	--	44 (1)
TR	66 (11)	20 (7)	46 (23)	58 (6)	45 (5)

Note. Heart rate elevation values are expressed as percent above baseline values for each subject. Values in () are number of times each critical incident occurred for each subject.

[a]Critical incident titles have been abbreviated as follows:

YP = Yelling at Player   ML = Missed Lay UP

RB = Referee Bad Call   TO = Time Out

GP = Good Play-Basket   PE = Poor Execution

OJ = Opening Jump   TR = Turnover

subjects did not encounter one of the critical incidents during their game as represented by a double hyphen on the table. HR was elevated above baseline values in each subject during all critical incidents. But, the extent of HR elevtion varied for each critical incident and for each subject.

Correlation of Fitness Level and Cardiac Response

Fitness was determined as the HR attained during exercise at a standard submaximal workload (150 watts) for each subject. These HR, which are assumed to be inversely related to fitness, are reported in Table 3. Average game HR was reported in Table 1 and the raw data representing the average HR during each critical incident for each subject can be found in Appendix E. A high, almost significant correlation was found between fitness level and average game HR (r = .80, $p > .05$). It was found that significant correlations ($p < .05$) existed between fitness level and average HR during three critical incidents (r = .94, opening jump; r = .87, time out; r = .85, referee bad call). The correlations between fitness level and average HR at each critical incident and between fitness level and average game HR can be found in Table 3. A fairly high correlation (r = .74) between fitness level and average HR at all critical incidents was found, although this was not significant.

Final conclusions cannot be drawn from the results of this study, however the significant correlations during

Table 3

Relationship Between Fitness and Heart Rate Response During Contest

	Coach				
Fitness	A	B	C	D	E
HR at 150 W	187	175	167	150	140

Situation	r[a]	r^2
Whole Game	.80	.64
YP	.73	.53
RB	.85*	.72
GP	.76	.58
OJ	.94**	.88
ML	.41	.17
TO	.87*	.76
PE	.72	.52
TR	.68	.46

Note. Raw data describing the average HR response during each critical incident can be found in Appendix E. Critical incident titles have been abbreviated in this table. Refer to Table 2 for complete terminology.

(Table continues)

[a]Correlations are derived from five values that represent each subject's fitness level (HR at 150 watts) and five values that represent each subject's average HR during a situation.

*$p < .05$. **$p < .01$.

three of the critical incidents and the other moderately high positive correlations found tend to reject the null hypothesis. Therefore, this study rejects the idea that there is no significant relationship between fitness level of female basketball coaches and their cardiac response during game situations.

Correlation of Incident Ranking and Cardiac Response

Table 4 illustrates the rank order for critical incidents as assigned by five expert veteran basketball coaches. It was judged through the ranking that turnovers should be associated with the highest amount of induced excitement, whereas the opening jump should be associated with the least. The results of this study displayed that a turnover actually caused the least amount of induced excitement, whereas the opening jump caused a relatively high amount of induced excitement. Table 4 also displays the HR response grand mean for all coaches during a particular critical incident. Spearman rank-order correlation between the grand mean HR response and the expert ranking of critical incidents revealed a negligible correlation ($r_s = -.08$, $p > .05$). As a result, the null hypothesis was accepted. Therefore, this study supported the idea that there will be no significant relationship between the ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents.

Table 4

Relationship Between Expert Ranking of Critical Incidents and Subjects' Heart Rate Response[a]

Rank	Incident	Grand Mean Heart Rate[b]
8	Turnover	96.0
7	Referee Bad Call	101.8
6	Yelling at Player	106.2
5	Poor Execution of Play	96.5
4	Time Out	96.5
3	Missed Lay Up	99.4
2	Good Play-Basket	100.3
1	Opening Jump	100.8

[a]$r_s = -.08$. [b]Grand mean is the mean of the average HR for all coaches during a particular incident.

Summary

The statistical analysis in this chapter indicated that the excitement induced during a basketball game causes elevation of HR beyond baseline rate in basketball coaches. The results also illustrate a significant relationship between fitness level of female basketball coaches and their cardiac response during game situations. However, the statistical analysis did not indicate a significant relationship exists between the ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents.

Chapter 5

DISCUSSION OF RESULTS

The purpose of this study was to investigate the relationship between the fitness level of female basketball coaches and their cardiac response during game situations. Elevation of HR above baseline values was used to examine the extent of induced excitement during game situations. Pearson product-moment correlations were computed to analyze the relationship between fitness level and cardiac response. Additionally, Spearman rank-order correlation established the relationship between the ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents. This chapter contains a discussion and interpretation of the results reported in chapter 4. Sections in this chapter include the following: (a) extent of cardiac response, (b) fitness level and cardiac response, (c) critical incidents and cardiac response, and (d) summary.

Extent of Cardiac Response

Elevation of HR above baseline values revealed that each coach's baseline HR was raised throughout the entire basketball game. The average elevation of baseline HR throughout the entire game for the subjects ranged from a low of 25% to a high of 65% above baseline values. There were low percent elevations of HR for Subjects B and E.

However, Subject B showed a 94 bpm baseline HR value, possibly caused by nervousness prior to the submaximal cycle ergometry test. Although her percent elevation of HR above baseline rate during a game was the lowest, this may have been a consequence of her high baseline HR. The low percent increase by Subject E may be explained by the monitoring of a game that greatly favored her team.

Porter and Allsen (1978) found that one of the coaches they monitored displayed a 120 bpm HR 5 min prior to the begining of a game. When the same coach was monitored a second time, his team was undefeated. Although his team was playing the same team they did the first time he was monitored, the coach only displayed a 96 bpm HR 5 min prior to the game. During the fourth quarter when the game was close, the coach's HR was 142 bpm. They concluded that HR increases before and during a game may be situation specific.

Three subjects (A, C, D) displayed a range of 57% to 65% elevation of baseline HR throughout the game. Husman et al. (1970) reported findings similar to these. In their case study of a varsity basketball coach's pulse rate during a game, their subject experienced a 62% elevation from resting HR as an average for the final 24 min of the game. They reported the subject's resting HR to be 83 bpm and his average HR for the final 24 min of the game to be 135 bpm.

Porter and Allsen (1978) reported much higher average elevation for their subjects as an entire group (99.6%). One of the subjects exhibited a 135 bpm average HR throughout the entire contest. This value was 126% over the baseline value. In summary, considering the results of the present study and some previous studies, baseline HR is substantially greater than resting HR throughout the entire game for basketball coaches. However, the degree to which HR increases may be due to situational and individual responses.

Percent elevation of HR over baseline values was also used to measure induced excitement during each critical incident of a basketball game. It was noted that baseline HR was elevated for each coach during each critical incident. Interestingly, no two subjects responded the same during any of the critical incidents. For example, during the opening jump the percent elevation over baseline HR for the five subjects was 71, 15, 79, 69, and 44, respectively. Dispersion of values during the other critical incidents followed the same pattern. Strangely enough, the percent elevation of baseline HR was not substantially higher for the subjects during critical incidents when compared to average HR during the entire game. Gazes et al. (1978) reported similar findings when monitoring 30 football and basketball coaches during the course of their games. Major game events such as touchdowns, pass interceptions, missed baskets, and time outs caused no significant increase in HR over game average. Considering the results of the present study and those reported by Gazes et al., baseline HR is elevated during critical times of a basketball game. However, this elevation is not substantially higher than that found throughout the entire game.

Fitness Level and Cardiac Response

Pearson product-moment correlations revealed that fitness level may play an integral role in the cardiac response of basketball coaches during a game. As fitness level increased, HR during critical incidents decreased. Significant correlations were found between fitness level and mean HR at three of the critical incidents and high, almost significant correlations were found during four other critical incidents. In fact, a high correlation was found between fitness level and mean HR at all of the critical incidents (r = .74, p > .05). In addition, a high, almost significant correlation was established between fitness level and average HR throughout an entire game (r = .80, p > .05). All these correlations were high, yet not all statistically significant possibly because of the low number of subjects (N = 5) in this study. To achieve significance, correlations had to reach a value of .81 or better.

Although many of the correlations did not reach this level, the relationship between fitness level and cardiac response is clearly unidirectional. For example, in this study the common variance between fitness level and average HR throughout an entire game as indicated by $\underline{r}^2$ was 64%. Generally, the correlations in this study revealed high common variance. For example, the common variance between fitness level and mean HR during the opening jump was 88%. This high common variance is important because it shows a mutual relationship between the two variables.

Although there have been no studies to date dealing with the relationship between fitness level and cardiac response of basketball coaches, results examining the relationship between fitness level and general stress responsiveness have appeared in the literature. Cantor et al. (1978) found that subjects displaying a low level of fitness had a significantly greater HR elevation in response to an arousing film segment. Holmes and Roth (1984) concluded that aerobic fitness influences cardiovascular response to performance of stressful tasks. In their study, low fit subjects displayed as much as 19 bpm greater HR than high fit subjects in response to a mildly stressful task.

Stress response differences between fit and unfit individuals may be related to cardiac adaptations. These adaptations include a lower resting HR and an increased stroke volume (Barnard, 1975). The lower resting HR associated with exercise training is probably due to increased activity of the parasympathetic nerves to the heart (Lamb, 1984). Although coaches participating in a fitness program may have the same absolute stress response, their HR response is decreased in magnitude during game situations due to the resting bradycardia associated with training. Since cardiac output remains the same with exercise training, stroke volume must increase to compensate for the decrease in HR. Barnard stated that the heart of a trained individual is doing less pressure work and more volume work at rest due to the bradycardia and increased stroke volume. Coaches participating in a fitness program have lower HR in response to stress. This may be due to increased stroke volume and parasympathetic activity that might be encountered in trained coaches during a basketball game.

In summary, because of the high common variance between fitness level and HR during critical incidents, this study rejects the idea that there is no significant relationship between fitness level of female basketball coaches and their cardiac response during game situations. This finding suggests that coaches may benefit from maintaining a high fitness level. This maintenance may aid in alleviating stress response during athletic contests and reduce the chance of developing coronary heart disease.

Critical Incidents And Cardiac Response

The result of the Spearman rank-order correlation did not demonstrate any relationship between ranking of critical incidents by basketball experts and cardiac response (r_s = -.08, p > .05). Previous studies have reported flawed judgment by coaches in similar realms (Mahoney, Gabriel, & Perkins, 1987; Martens, 1977).

Mahoney et al. (1987) assessed psychological skills relevant to exceptional athletic performance by administering a questionnaire to a national sample of athletes. They also had 16 leading sport psychologists complete the questionnaire as they thought the "ideal" athlete may complete it. Interestingly, the sport psychologists and athletes differed in their assessment of idealized specific skills and practices such as visual and kinesthetic mental preperation. In addition, the sport psychologists' estimates of the importance of team orientation and attributions were also different from those reported by athletes.

In an attempt to determine the validity of the Sport Competitive Anxiety Test (SCAT), a comparison of SCAT with another measure of competitive anxiety trait was performed by Martens (1977). Martens had coaches of high school girls basketball teams rate competitive anxiety trait of players in noncompetitive and competitive situations. He then compared the results with the results of SCAT completed by the players. He found that low and nonsignificant correlations were obtained between the coaches' ratings and SCAT.

In summary, due to the results of the present study and findings presented in the literature, the null hypothesis was accepted. Therefore, the study supported the idea that there is no significant relationship between ranking of critical incidents by experts and cardiac response by subjects during critical incidents. It may be unknown to basketball coaches which facets of a basketball game really causes the most physiologically manifested stress. Or, perhaps, the incidents that cause the most stress in the five expert veteran basketball coaches differ from those of the subjects in the present study.

A change in the methods of this study may possibly negate the finding that there is no significant relationship between ranking of critical incidents and cardiac response. In this study, the ranking of the induced excitement associated with the critical incidents was performed by five veteran basketball coaches who were not subjects in the study. In addition, the critical incident ranking lacked situation specificity. It may be possible for arousal during a critical incident to vary according to the score of the game, as an example. To test the validity of acceptance of the null hypothesis, the critical incidents perhaps should be ranked by the subjects participating in the study, and game scores considered during the analysis.

Summary

The results presented in this study indicate that there is elevation of baseline HR throughout the entire game for basketball coaches. Although, there is elevation of baseline HR during critical times of a basketball game, this elevation is not substantially higher than that found throughout the entire game. The high common variance between fitness level and HR during critical incidents suggests that there is a unidirectional relationship between the two variables. However, the results of this study must be considered in light of the limited scope that it encompasses. This relationship may be related to the lower resting HR or increased parasympathetic activity of fit individuals, although these mechanisms were not studied at the present time. The results also display a negligible correlation between ranking of critical incidents by basketball experts and cardiac response of subjects during critical incidents. It may be unknown to basketball coaches which facets of a basketball game really causes the most physiologically manifested stress.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

<u>Summary</u>

The purpose of this study was to investigate the relationship between fitness level of female basketball coaches and their cardiac response during game situations. The relationship between ranking of critical incidents by basketball experts and cardiac response by the subjects during the critical incidents was also examined. The subjects were five female college basketball coaches ranging in age from 31 to 37 years. The study consisted of two testing sessions for each subject. One session encompassed cardiac Holter monitoring during a basketball game. The other session was a submaximal cycle ergometry test in which fitness level was predicted. Amount of excitement induced during critical incidents was evaluated by HR through ranking of eight critical incidents in a basketball game and estimated by five expert veteran basketball coaches.

Pearson product-moment correlations examined the relationship between fitness level and cardiac response, and Spearman rank-order correlations assessed the relationship between ranking of critical incidents by basketball experts and cardiac response by the subjects during these critical incidents. Results revealed significant correlations between fitness level and cardiac response during three critical incidents of a basketball game. High positive correlations, although not statistically significant were found between fitness level and cardiac response during four other critical incidents and throughout the entire game. As fitness level increased, cardiac response to the stressful situation decreased. A negligible correlation was found between ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents.

Conclusions

The results of this study support the following conclusions:

1. Baseline HR is elevated throughout an entire game for basketball coaches. However, the elevation of HR during critical incidents identified in this study is not substantially higher than that found throughout the entire game.

2. The statistical evidence displayed in the results of this study support a unidirectional relationship between fitness level of female basketball coaches and their cardiac response during game situations. As fitness level increases, cardiac response to stressful situations decreases.

3. There is no significant relationship between ranking of critical incidents by basketball experts and cardiac response by subjects during critical incidents.

Recommendations for Further Study

The findings of this investigation lead to these recommendations for further study:

1. A study should be conducted involving a larger number of subjects. This would allow for greater generalizability and greater statistical power.

2. A study should be conducted in which each subject is monitored two or three times throughout the course of a season. This may allow the investigator to obtain HR data during different game conditions. One game may be highly contested, whereas another may be less competitive; game factors should be considered.

3. A study should be conducted in which the two opposing coaches are monitored at the same time. This would allow for a larger data collection. In addition, HR responses during the critical incidents of the game may be evaluated for both coaches in order to view possible similarities and differences.

4. A study should be conducted in which the participating subjects rank the critical incidents of a basketball game. The critical incidents should have game scores considered to provide situational specificity.

5. A study should be undertaken to examine the relationship between fitness level and cardiac response in which game scores are considered as influencing the impact of the critical incidents.

This means that during the data collection, the investigator would have to record the score of the game everytime a critical incident is recorded so correlations between HR response during critical incidents at different game scores and fitness level can be analyzed.

6. A study should be undertaken that examines the relationship between fitness level and cardiac response in which two subject groups are used. One group would participate in an aerobic fitness training program from a period of time prior to the study and continue throughout the course of the study. The other group would not participate in any sort of fitness training from a period of time prior to the study and throughout the course of the study. This may allow the investigator to really see if aerobic fitness training influences cardiac response of basketball coaches during games.

Appendix A

INFORMED CONSENT FORM

1. a) Purpose of the study. To investigate the cardiac responses of basketball coaches to psychological stress induced during game situations.

b) Benefits. This data will provide information about how coaches' cardiovascular systems respond to the emotional demands of game situations. It may also provide valuable information regarding the stress placed upon the individual due to coaching and may lend insight into how to minimize this stress.

2. Method. You will be required to fill out a medical history report prior to physiological testing. Before being tested, a heart rate monitoring device will be placed on you by the investigators. Your heart rate will be monitored while standing and pacing back and forth for a few minutes. To determine physical work capacity, you will be required to ride on an exercise bike at a rate of 50 revolutions per min for 6 to 10 min. The entire testing will take less than 1 hr. In addition, you will be monitored during one basketball game. The Holter monitor will be placed on you 1 hr prior to the game and will be removed after the game at your convenience. The Holter monitor is an unobtrusive

device that will not interfere with your game coaching. After the monitor is removed, you will be asked some questions concerning your team's performance. This will take less than 5 min.

3. Will this hurt? No psychological risks are evident. Of course, there is always some risk involved when exercising. This risk will be minimized through proper supervision and exercising at a light work load. Blood pressure will also be monitored throughout the exercise period.

4. Need more information? Additional information can be obtained from the investigators, Jerry Rickrode and Greg Petrosky (272-5525). Dr. Fisher (274-3112) and Dr. Sforzo (274-3359) may also be contacted. All questions are welcomed and will be answered.

5. Withdrawal from the study? Participation is voluntary. You are free to withdraw your consent and discontinue at any time.

6. Will the data be maintained in confidence? All data will be confidential. Once data are collected, names of the subjects will be eliminated. You may see general results of the study and your own results upon request.

7. I have read the above and I understand its contents and I agree to participate in the study. I acknowledge that I am 18 years of age or older.

_________________________________ ____________________

Signature Date

Appendix B

MEDICAL HISTORY FORM

Name: Date:

Age:

Sex:

Check if Yes

Past History

(In the past have you ever had?)

A. Rheumatic Fever ( )

B. Heart Murmur ( )

C. High Blood Pressure ( )

D. Heart Trouble:

Rhythm Abnormalities ( )

E. Disease of Arteries ( )

F. Varicose Veins ( )

G. Emotional Disorders ( )

H. Lung Disease ( )

I. Diabetes ( )

J. Epilepsy ( )

K. Injuries to back, knees, ankles ( )

What kind?____________________

L. Stroke/Heart Attack ( )

How long ago?_________________

M. Operations ( )

What kind?____________________

N. Other ( )

If other is checked explain here:____________________

Present Symptoms

(Have you recently had?)

A. Chest Pain	( )
B. Shortness of Breath	( )
C. Heart Palpitations	( )
D. Light Headedness	( )
E. Cough on exertion	( )
F. Coughing up blood	( )
G. Back Pain	( )
H. Arthritis	( )
I. Swollen Legs	( )
J. Chronic Thirst	( )
K. Loss of Consciousness	( )

Family History

(Have any blood relatives had?)

A. Heart Attacks	( )	Age?
B. Heart Operations	( )	"
C. High Blood Pressure	( )	"
D. Diabetes	( )	"
E. High Cholesterol	( )	
F. Congenital Heart Disease	( )	
G. Sudden Death	( )	Age?
H. Other major illnesses	( )	

Explain here:____________________

<u>Risk Factors</u>

	Yes	No
1. Smoking	()	()

How long?

How much?

2. Do you eat three meals a day Yes or No

   Type of food mostly--red meat, fish, fruits & vegetables

3. Do you presently exercise three times a week for 20-30 minutes? Yes or No (circle response)

4. Is your occupation Sedentary (), Inactive (), Active (), Heavy Work()

5. Do you have discomfort, shortness of breath, or pain with exercise? Yes or No

6. Are you presently on any medications? Yes or No

   If yes, name the medications:________________________

Appendix C

INFORMED CONSENT FOR AN EXERCISE TEST

1. Explanation of the exercise test

You will perform an exercise test on a cycle ergometer or a motor-driven treadmill. The exercise intensity will begin at a level you can easily tolerate and will be advanced in stages, depending on your fitness level. We may stop the test at any time because of signs of fatigue, or you may stop when you wish because of personal feelings of fatigue or discomfort.

2. Risks and discomforts

There exists the possibility of certain changes occurring during the test. They include abnormal blood pressure, fainting, disorder of heart beat, and, in rare instances, heart attack or death. Every effort will be made to minimize these through the preliminary examination and by observations during testing. Emergency equipment and trained personnel are available to deal with unusual situations which may arise.

3. Benefits to be expected

The results obtained from the exercise test may assist in the diagnosis of possible illness or in evaluating in which type of physical activities you might engage with no or low hazards.

4. <u>Inquiries</u>

Any questions about the procedures used in the exercise test or in the estimation of functional capacity are encouraged. If you have any doubts or questions, please ask us for further explanations.

5. <u>Freedom of consent</u>

Your permission to perform this exercise test is voluntary. You are free to deny consent if you so desire.

I have read this form and I understand the test procedures that I will perform. I consent to participate in this test.

____

Signature of Patient

__________________ ______________________________

Date Witness

Questions: ____

____

Response: ____

____

Physician signature: optional

Appendix D

CRITICAL INCIDENT RANKING

Opening jump ball

Referee bad call

Turnover

Yelling at your player

Missed lay up

Poor execution of play

Time out after opposing team gathers momentum

Good play-basket for your team

Please place a single number beside each of the critical incidents (1-8). The incident numbered 8 will be the one that elicits the most arousal in you. The incident numbered 1 will be the one that elicits the least arousal in you.

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Appendix E

SUBJECTS' AVERAGE HR DURING CRITICAL INCIDENTS

	Coach				
Incident	A	B	C	D	E
YP	120	129	76	80	83
RB	125	118	90	81	90
GP	120	129	88	80	91
OJ	116	108	100	88	92
ML	100	136	76	88	--
TO	120	113	90	80	88
PE	124	112	84	--	92
TR	113	113	82	82	93
Weighted Mean	117	122	83	83	90

Note. Weighted mean is the average HR response for each subject during all critical incidents. It is not an average of the values in the Appendix. This is due to different number of occurence times for each critical incident. Refer to Table 2 for names of critical incidents that are abbreviated in this appendix.

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