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The effect of dextrose ingestion on cardiovascular endurance

Judith M. Axford

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Abstract

THE EFFECT OF DEXTROSE INGESTION
ON CARDIOVASCULAR ENDURANCE

by

Judith M. Axford

This study was designed to investigate the effectiveness of dextrose on cardiovascular endurance. The subjects were nineteen male students enrolled at Loma Linda University in Riverside, California. The subjects were exercised to their maximum while being tested on the treadmill. Subjects were each tested twice. Thirty minutes before exercising, they ingested one hundred grams of dextrose for one test and ten ounces of sugar-free Kool-aid for the second test. The difference in exhaustion times was then recorded.

The data indicated that dextrose ingestion decreased exhaustion time on the treadmill. Subjects were able to exercise for a longer period of time after the intake of a sugar-free substance.

It is concluded that the ingestion of dextrose, as used in this study, decreases cardiovascular endurance.

LOMA LINDA UNIVERSITY

Graduate School

THE EFFECT OF DEXTROSE INGESTION ON CARDIOVASCULAR ENDURANCE

by

Judith M. Axford

A Thesis in Partial Fulfillment

of the Requirements for the Degree

Master of Science in Physical Education and Health

March 1984

Each person whose signature appears below certifies that this thesis in his opinion is adequate, in scope and quality, as a thesis for the degree Master of Science.

Walter S. Hamerslough, Chairman
Walter S. Hamerslough, Professor of Physical Education

Vernon L. Scheffel
Vernon L. Scheffel, Professor of Physical Education

Kenneth I. Burke
Kenneth I. Burke, Professor of Nutrition

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Chapter 1

INTRODUCTION

Interest in physical fitness has rapidly increased in the last decade. Participation in walking and running increased seven hundred percent between 1976 and 1980. (13:5) Extensive research in improving physical potential has been generated by this increased interest in health and physical performance. (7:69)

Nutrition is playing a larger role in the development and care of all athletes, from the Olympic champion to the weekend jogger. (17:1) Some of the questions athletes are asking today have to do with nutrition and its influence on performance. Is there a diet better than all others for sustaining physical ability? Is there an eating pattern that will bring the competitor to his peak effort for a contest? Is there a pre-event snack that will give an extra ounce of energy? (29:141)

In the search for a meal plan that can help performance, athletes have experimented in a number of ways with their food habits. There are stories of people like Paul Anderson, a top weight lifter, who drinks a blood and tomato juice mix before competing. Wayne Stetinia, a top bicycle racer, practices vegetarianism. Park Barner, a world record holder in the 100 kilometer run, fasts before each race. Ron Blumberg, a well-known baseball player, gorges on food. (27:49) The former American record holder in the marathon, Bill Rodgers, is known as a "junk food junkie." (13:133) However, research has consistently shown that nutrition does effect physical performance.

Marathon runners have discovered that what and when they eat can influence how well and how long they run. (32:18)

Christensen and Hanson have shown that a diet high in complex carbohydrate can have a profound effect on stamina. A high-fat, low-carbohydrate diet has the opposite effect. Individuals on such a diet have become exhausted in half the normal time when performing heavy exercise. (32:18)

For years it was thought that protein was the food element which should be increased in the diet of athletes. Research has indicated that a diet high in protein does not alter athletic performance and may be detrimental to health and longevity. (21:54) Nutritionists now agree that it is not more protein that is required but more carbohydrate. (16:22, 32:18)

Voit and von Pettenkofer showed urinary excretion of nitrogen, a byproduct of protein metabolism, was not affected by strenuous prolonged exercise. This has been confirmed repeatedly, indicating that protein is not the fuel used to any great extent for muscular work. (10:257) This was again confirmed in an experiment involving cross-country skiers. There was no noticeable difference in the amount of protein metabolized by those who skied twenty to fifty miles a day as compared to the skiers who took a vacation from their sport. (4:9)

Carbohydrates are the most efficient and readily available source of energy. (33:12) Oxygen is utilized ten percent more efficiently when carbohydrate is burned as opposed to protein or fat. One liter of oxygen yields five calories with carbohydrate metabolism, 4.5 calories with protein metabolism, and 4.6 calories with fat metabolism. (24:377)

There are two major types of carbohydrates--complex and simple. Complex carbohydrates are naturally occurring sugars present in fruits, vegetables, and grains. These sugars are disaccharides or polysaccharides composed of a linkage of glucose residues. (31:147) Because digestion of complex carbohydrates is required prior to absorption in the small intestine, the rise in blood glucose tends to be slow and steady.

Simple carbohydrates are sugars that are used in prepared foods. These sugars are monosaccharides or disaccharides that require little or no digestion for absorption. Therefore, there is immediate and rapid absorption causing the blood glucose level to rise quickly. A state of hyperglycemia ensues shortly after ingestion. To compensate for this hyperglycemic state, the pancreas is stimulated to produce and secrete extra insulin. The excessive insulin lowers glucose levels below normal values creating a condition of hypoglycemia. (22:55,56)

Hypoglycemia is detrimental to endurance potential. In seeking to avoid this, it is popular for an athlete to consume sugar prior to and during competition to raise the blood sugar for "quick energy." However, for reasons previously discussed, athletic drinks, candy bars, honey, and sugar cubes may not be the answer to the blood glucose maintenance and lasting energy. In an attempt to determine the validity of the claims made concerning athletic drinks or any other concentrated sugar source, this study investigated the influence of a glucose solution on exercise time to exhaustion.

Need for the Study

Questions regarding how to correct fluid loss, replace electrolytes, and avoid hypoglycemia are not new to endurance athletes. Athletic drinks were developed in an attempt to find an answer. These drinks consist of water, glucose and electrolytes. Glucose solutions such as Gatorade, Quick-Kick, and ERG are very popular and are often recommended before, during and after an athletic event. However, research has indicated that there is a need to question and be cautious concerning the use of these solutions. Glucose retards the emptying rate of water from the stomach, draws fluid out of the extracellular spaces, and taken before a race can result in ultimately lowering the blood sugar level. (2:442, 25:241)

The ingestion of sugar prior to competition is widely practiced because it is considered to give "quick energy." This study was conducted to investigate the effect that simple carbohydrate has on endurance.

The Problem Statement

The purpose of this study was to determine the effect of the ingestion of dextrose prior to exercising, on cardiovascular endurance.

Hypothesis

It was hypothesized that the ingestion of dextrose thirty minutes prior to exercise would have no significant effect on exhaustion times on the treadmill.

Assumptions

In order to accept the interpretations of the findings of this study, it was necessary to acknowledge the following assumptions:

1. On all tests, each subject exercised to exhaustion.

2. Subjects were not able to distinguish between the drink with dextrose and the drink without dextrose.

Limitations

Following are limitations of this study:

1. The level of performance could vary from day to day according to the state of mind of the subject.

2. There was no attempt to control the amount or type of exercise in which each subject engaged.

Delimitations

The following are delimitations which were acknowledged in this study:

1. Nineteen male subjects were involved.

2. Running was the only means by which the influence of dextrose ingestion was determined on cardiovascular endurance.

3. Ages of the subjects ranged from eighteen to twenty-six years.

4. No food was allowed three hours prior to testing.

Definitions and Terms

The following terminology was employed throughout the study:

Dextrose. Dextrose is synonymous with glucose. It is the basic structural unit of disaccharides, polysaccharides, starch, and cellulose. Glucose is the form of carbohydrate to which all other carbohydrates are eventually converted for absorption, transport and utilization.

Normoglycemia. Normoglycemia refers to a blood glucose level within normal range (sixty to one hundred twenty milligrams percent).

Hyperglycemia. Hyperglycemia refers to a blood glucose level above normal range (greater than one hundred twenty milligrams percent).

Hypoglycemia. Hypoglycemia refers to a blood glucose level below normal range (less than sixty milligrams percent).

Chapter 2

REVIEW OF THE LITERATURE

Chapter two is a collection of research material that relates to the effect of simple carbohydrate ingestion on cardiovascular endurance. As a basis for this study, literature was reviewed in the following areas: Glucose and exhaustion time, carbohydrate and energy, glucose and the central nervous system, glucose and dehydration, glucose solutions, glucose and the endocrine system, and spacing of the pre-event meal.

Glucose and Exhaustion Time

Blood sugar level was investigated on five contestants at the 1924 Boston Marathon. It was noted that the winner started and finished with the highest blood glucose level. It is well established that a significant drop in blood glucose is a primary factor in limiting endurance potential. (12:764, 19:321) The potential for heavy prolonged exercise is directly related to the initial glycogen content of the working muscle. (10:257)

Brooke cites a study that was conducted in which glycogen metabolism in human skeletal muscle was analyzed to determine exhaustion time. Carbohydrate metabolism increased both in absolute and relative terms with an increased workload. The importance of muscle glycogen increases with an increased workload, and exhaustion occurs at the same time as depletion of glycogen stores. (10:257)

Carbohydrate and Energy

The proportion of carbohydrate utilized as an energy source during muscular work rises with increasing workloads. Houston, Reid, and Green found that at workloads eighty-five to ninety percent of maximum oxygen uptake, carbohydrate provides virtually all of the muscular energy. (19:324)

Christensen and Hansen examined the role of fat and carbohydrate in energy metabolism. Subjects on a very high-fat diet for several days, in which less than five percent of the caloric intake was derived from carbohydrates, were able to work for only one hour. Throughout the work period, fat was virtually the only source of fuel. When the subjects derived ninety percent of their food calories from carbohydrates, the standard load could be performed up to four hours. In this case, fat contributed twenty-five percent of the metabolic fuel, compared with more than seventy percent when the diet was rich in fat. The subjects were able to work four times as long when carbohydrate was the main source of fuel. It is noteworthy that when two hundred grams of glucose were ingested at the time of exhaustion, the subjects were able to continue the work for another hour. (5:458)

Bergstrom and his colleagues developed a technique called glycogen loading that has been adopted by many runners. This involves manipulating the training and diet to produce above-normal levels of muscle and liver glycogen. On examination of the muscle tissue of glycogen loaders, there was found about twice as much stored glycogen as compared to the non-loaders. (7:69, 32:18,19) Liver glycogen is used as a reserve supply for keeping up the blood sugar level and muscle glycogen is used to meet energy needs of the exercising muscle. (9:57)

The importance of muscle glycogen stores during prolonged hard physical work has been well established. Blood glucose and its role during exercise is less clear.

In a study using trained racing cyclists, Brooke, Davies, and Green, compared the effect of a glucose syrup drink to a normal work diet. The drink was administered every twenty minutes during exercise. On the glucose syrup drink, there was marked improvement in efficiency demonstrated by the amount of oxygen being utilized. This resulted in greater endurance. (10:258)

Glucose and the Central Nervous System

Simonson found that the drop in blood sugar is as important for the development of fatigue in prolonged work as the exhaustion in muscle glycogen stores but the site of fatigue under hypoglycemic conditions is the central nervous system rather than the muscle. (30:39) The beneficial effects of carbohydrate feeding may lie in the contributions it makes to metabolism in the central nervous system. The raised concentration of carbohydrate at cellular level may benefit neuromuscular integration, resulting in extending work performance time. (10:262)

Glucose and Dehydration

It is suggested by some coaches and researchers that in the long endurance events the athlete should consume an isotonic solution of glucose in small portions at frequent intervals. (6:1006) Solutions with too much sugar, hypertonic solutions, should not be taken as they exert an osmotic effect, drawing water in the stomach from extracellular spaces. (6:1004)

Distance runners and skiers often have stations periodically along the way at which they take sugar, salt and water solutions. These stations are usually set at every two-and-a-half miles. For years it was believed that these solutions increased energy. However, in some athletic circles, these opinions are changing. The glucose content is considered to be actually detrimental to performance. (23:34, 28:80)

Astrand has contended that consumption of excessive quantities of sugar several hours before an event may drastically impair work capacity. (3:1776) Excessive amounts of dextrose pills, glucose, sugar cubes, honey, or hard candy, should be avoided because they draw fluid into the intestinal tract and add to the problem of dehydration. Adequate hydration is the crucial ingredient before, during and after a race. (14:335, 21:56) Dehydration may cause fatigue, an increased heart rate and body temperature, heat cramps, heat exhaustion, or the more serious and sometimes fatal heat stroke. (8:76)

Water empties more rapidly than drinks containing starch or glucose. (20:275) Plain water has been shown to leave the stomach fifty percent faster than a glucose solution. (26:141)

Glucose Solutions

Cade studied the effect that replacement of fluid, electrolytes, and glucose had on physical performance. The exercise was a run/walk protocol for seven miles, three days each week. During one run, the subjects were not given anything to drink. During a second run, they received a glucose electrolyte solution, and during the third run, the subjects drank water in any volume they desired during each walk interval. (11:150)

When the athletes took nothing by mouth or drank water during the exercise, there was no significant difference in their performance. When given the glucose solution, the athletes completed the run significantly faster. Whether this was due to the maintenance of blood sugar or the solution's effect in tempering the rise in body temperature is not clear. (11:155)

Haldi and associates studied the effect of the use of glucose before exercise. Solutions of twenty grams of glucose or fructose were ingested thirty minutes prior to a work task. The efficiency was the same as when water was given. No changes in muscular efficiency were noted after other experimental conditions using fifty grams of glucose or after the ingestion of a high carbohydrate meal prior to exercise. (18:123) Abrahams, discussing Olympic athlete's, noted that sugar given prior to an event had no effect on an athlete's performance. (1:268)

Glucose and the Endocrine System

Costill studied the delay between glucose ingestion and its introduction into the blood system of resting and exercising men. Exercise appeared to have little or no effect on intestinal glucose absorption. The liver appeared to decrease its contribution to blood glucose from thirty to seventy-five minutes after the glucose feeding. (12:764)

Small amounts of carbohydrate taken up to an hour before competition are not harmful but probably do no good. Simple sugars in large amounts are not recommended. They cause a surge in the release of insulin and thus subsequent hypoglycemia. (2:442)

Soman studied the effect of physical training and tissue sensitivity to insulin. Trained athletes typically have normal glucose tolerance but a diminished plasma insulin level. The suggestion is that the body's sensitivity to insulin is enhanced with physical exercise. With the increase in glucose efficiency, the physically trained are not as detrimentally affected with the use of concentrated sugar. (15:1869)

Feinkel conducted a study to determine the acute hormonal change that accompanied dietary manipulation. Plasma insulin level was found to rise virtually instantaneously after oral glucose ingestion in normal subjects, and then decline in parallel with a decrement in serum glucose levels. (15:1869)

Summary

In the athletic world, simple carbohydrates, such as glucose replacement drinks, sugar cubes, honey, and other substances that contain concentrated sugar, have long been recommended for use before and during physical exertion. This consumption is intended to provide immediate replenishment of sugar to the exercising muscles.

However, in endurance activities, this surge in blood sugar appears to be detrimental to maximum physical performance. Simple carbohydrates do not require digestion and therefore raise the blood sugar immediately after ingestion. The athlete is now hyperglycemic. A high blood sugar level causes an overproduction of insulin which ultimately results in lowering the blood sugar. The athlete is now hypoglycemic. Hypoglycemia is the exact opposite state the athlete was hoping to achieve, and what he was trying to avoid in the first place, with the sugar ingestion. Also, simple carbohydrates draw water from extracellular spaces which contributes to dehydration, a primary enemy to an athlete.

Chapter 3

PROCEDURES

Subjects

Subjects for this study were nineteen male students enrolled at the La Sierra Campus of Loma Linda University in Riverside, California. Testing was done during the spring and summer quarters of 1981. The age range of subjects was eighteen to twenty-six years with the mean age being twenty-two. Subjects were all volunteers. Activity levels ranged from sedentary to very active, with the majority being moderately active.

The Measuring Instrument

Subjects involved in the study completed a medical history form and a written consent form. (See Appendices A and B.) The test was performed on a Quinton 18-49 treadmill controlled by a Quinton 644 programmer using the Bruce Protocol. (See Appendix C.) Heart rate was monitored by a Hittman Starr 100 electrocardiograph and blood pressure by an aneroid sphygmomanometer. The duration of time until exhaustion on the treadmill was the criterion measure.

Testing Protocol

Each subject was tested on two separate occasions. Half the subjects were given ten ounces of fluid containing one hundred grams of dextrose thirty minutes before their first test and ten ounces of sugar-free Kool-aid, in which saccharin was substituted for the sugar requirement, thirty minutes before their second test. The other half were given the sugar-free Kool-aid first and the dextrose drink for their second test. This was done to eliminate the learning factor which might improve performance on the second test.

The time of day for testing ranged from early afternoon to early evening. The interval between testing averaged six days. Although subjects were not monitored the day of the test, they were told not to engage in strenuous activity. The only dietary guideline was that no food should be ingested at least three hours before testing. No exercise was allowed between the time of fluid ingestion and the treadmill test.

Collection of Data

Testing was administered in the Human Performance Laboratory of the Department of Health, Physical Education, Recreation of Loma Linda University, La Sierra Campus. Subjects wore shorts, socks, and running shoes.

Upon entering the laboratory for the first test, subjects completed the medical history and consent forms, which took approximately ten minutes. During this time, they ingested the solution. Fully rested, they reclined in a supine position on an examination table, where blood pressure was taken and a resting 12-lead electrocardiogram was administered to rule out heart-related health risks. The forms and resting EKG were not necessary for the second test. During the thirty minute waiting period, the subjects studied, visited and/or played card games.

Thirty minutes after ingesting the solution, each subject was connected to a 3-lead electrocardiogram, the points of connection being on the manubrium and V5 position on both sides of the chest. The subject was seated, hyperventilated for twenty seconds, and monitored with the EKG to aid in ruling out stress-related cardiac problems. There was no warm-up prior to the test. During the test, blood pressure was taken every three minutes and heart rate was monitored the last ten seconds of each minute. The end point of the test was a verbal statement of exhaustion by the subject. At this point, the time was noted and the subject was monitored while he cooled down to within ten percent of his resting blood pressure and heart rate.

Treatment of Data

To determine if a significant difference existed in the amount of time subjects exercised after ingesting dextrose as compared to exercising after ingesting sugar-free Kool-aid, a t-test was conducted. A difference was considered significant if it reached the .05 level of confidence.

Chapter 4

ANALYSIS AND INTERPRETATION OF DATA

The following chapter presents the means and standard deviations for the amount of time the subjects exercised on the treadmill. This is followed by a t-test comparing the scores of the subjects on the two tests. Following the t-test calculation is a discussion of plausible explanations for the outcome of the study.

Table I

MEANS AND STANDARD DEVIATIONS OF TIME ON TREADMILL

Tests	Time (minutes) Mean	Standard Deviation
Dextrose	14.60	1.947
Sugar-free Kool-aid	15.24	1.923

Between-group Analysis

A t-test was administered to determine if a difference existed between the amount of time the subjects exercised on the treadmill in the two tests.

Table II

COMPARISON OF DEXTROSE TEST TO SUGAR-FREE TEST

Dextrose Test Mean	Sugar-free Test Mean	Mean Difference	t-ratio*
14.60	15.24	.64	2.58

*A t-ratio of 2.10 indicates significance at the .05 level of confidence.

Table 1 compares the exercise times of the subjects on the treadmill. The mean time for subjects on the dextrose test was 14 minutes, 36 seconds. Subjects on the sugar-free test exercised for a mean time of 15 minutes, 14.4 seconds which was 38.4 seconds longer. This difference was significant at the .05 level of confidence.

Discussion

This study was designed to investigate the effect of dextrose ingestion on cardiovascular endurance. A significant difference was determined in exhaustion times of the subjects between the two tests. The hypothesis that the ingestion of dextrose thirty minutes prior to exercise would have no significant effect on exhaustion times on the treadmill is rejected. The significant t-ratio indicates that subjects exercised longer when sugar-free Kool-aid was ingested than when dextrose was ingested.

This significant difference appears to be due to the ultimate hypoglycemic effect of simple carbohydrate ingestion. It is well established that physical endurance is directly correlated with serum glucose levels. (12:764, 19:321) Small amounts of simple carbohydrates taken up to an hour prior to exercise are not considered harmful, but probably do no good. Simple carbohydrates in large amounts, however, are not recommended. (2:442) These carbohydrates, such as dextrose pills and glucose drinks--the popular "quick energy" foods for athletes require little or no digestion for absorption. Therefore, there is immediate and rapid absorption causing the blood glucose level to increase quickly. A state of hyperglycemia ensues shortly after ingestion, thus the condition of "quick energy."

To compensate for this hyperglycemic state, the healthy, non-diabetic pancreas is stimulated to produce and secrete extra insulin. Plasma insulin level rises virtually instantaneously after oral glucose ingestion. The excessive insulin is then responsible for a parallel decrement in serum glucose, lowering the level below normal and creating a hypoglycemic state. This is the very condition the athlete was trying to avoid in the first place because it is detrimental to performance potential. (22:55-56)

It was observed that with the dextrose there was some complaint from the subjects of cramping and nausea immediately following the exercise. This may have been due to the osmotic effect of the hypertonic solution drawing fluid from extracellular spaces into the stomach and intestinal track. (6:1004)

The one hundred grams of dextrose used in this study is the same amount administered in a typical glucose tolerance test for diabetes. This amount is known to cause an initial state of high blood sugar in all individuals. Because none of the subjects had a known history of diabetes, it can be assumed that the pancreas responded to the simple carbohydrate normally, resulting in an ultimate condition of low blood sugar.

In contrast to simple carbohydrates, complex carbohydrates create a slow, steady rise in blood sugar because they require digestion. Therefore, the pancreas is not overstimulated, the eventual hypoglycemic effect is avoided, and stamina is enhanced. (32:18) For this reason, spaghetti and fresh fruit often comprise pre-event meals--pastas are high in complex carbohydrate, and the carbohydrate in fruit is accompanied by fiber which keeps its absorption slow and steady.

In this study, exercise potential was reduced when the subjects ingested dextrose. The ingestion of dextrose, a simple carbohydrate, creates a state of hypoglycemia in a relatively short period of time. Therefore, it can be concluded that simple carbohydrates and the resulting hypoglycemic condition significantly limit cardiovascular performance.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Purpose

The purpose of this study was to determine the effect of dextrose ingestion on cardiovascular endurance.

Procedures

Subjects for this study were nineteen male students enrolled at Loma Linda University during the spring and summer quarters of 1981. All subjects were volunteers and exercised to their maximum while being tested on a treadmill. Subjects were each tested twice. Thirty minutes before exercising, they ingested one-hundred grams of dextrose for one test and ten ounces of sugar-free Kool-aid for the second test. The difference in exhaustion times was then recorded.

Results

Data indicate that subjects perform significantly longer when the sugar-free Kool-aid was administered as compared with the dextrose.

Conclusion

It is concluded that the ingestion of dextrose, as used in this study, decreases cardiovascular endurance.

Recommendations

For further study of the effect of simple carbohydrate on cardiovascular endurance the researcher recommends that additional studies be conducted with the following considerations:

1. The use of a common runner's drink such as Gatorade or ERG.

2. Vary the amount of glucose given and when administered, such as before and/or during exercise.

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APPENDICES

LOMA LINDA UNIVERSITY
HUMAN PERFORMANCE LAB

PRE-EXERCISE MEDICAL HISTORY FORM

Name ______________________________ Date ______________

(Check X if Yes)

PAST HISTORY
(Have you ever had?)

Rheumatic Fever	( )
Heart Murmur	( )
High Blood Pressure	( )
Any Heart Trouble	( )
Disease of Arteries	( )
Varicose Veins	( )
Lung Disease	( )
Operations	( )
Injuries to Back, etc.	( )
Epilepsy	( )

FAMILY HISTORY
(Have any of your relatives had?)

Heart Attacks	( )
High Blood Pressure	( )
Too much Cholesterol	( )
Diabetes	( )
Congenital Heart Diseases	( )
Heart Operations	( )
Other	( )

PRESENT SYMPTOMS REVIEW
(Have you recently had?)

Chest Pain	( )
Shortness of Breath	( )
Heart Palpitations	( )
Cough on Exertion	( )
Coughing of Blood	( )
Back Pain	( )
Swollen, Stiff or Painful Joints	( )
Do you awaken at night to urinate?	( )

Explain: ______________________________

____

RISK FACTORS

1. Smoking

	Yes	No	
Do you smoke	( )	( )	
Cigarettes	( )	( )	How many?_____ How many years?_____
Cigar	( )	( )	How many?_____ How many years?_____
Pipe	( )	( )	How many times a day?_____ How many years?_____

How old were you when you started?__________

In case you have stopped, when did you?______________________

Why?______________________________________

PRE-EXERCISE MEDICAL HISTORY FORM
(Continued)

RISK FACTORS (Continued)

2. DIET
   What is your weight now?_____ One year ago?_____ At age 21?______
   Are you dieting?_____ Why?______________________________

3. EXERCISE
   Do you engage in sports?______________
   What?______________________________ How often?__________
   How far do you think you walk each day?____________________
   Is your occupation: Sedentary ( ) Active ( )
   Inactive ( ) Heavy Work ( )
   Do you have discomfort, shortness of breath, or pain with moderate exercise?______________________________
   Specify______________________________
   Were you a High School or College athlete?____________________
   Specify______________________________

LOMA LINDA UNIVERSITY
HUMAN PERFORMANCE LAB

Informed Consent for Graded Exercise Test

You will perform a graded exercise test on a bicycle ergometer and/or a motor-driven treadmill. The work levels will begin at a level you can easily accomplish and will be advanced in stages, depending on your work capacity. We may stop the test at any time because of signs of fatigue or you may stop when you wish to because of personal feelings of fatigue or discomfort. We do not wish you to exercise at a level which is abnormally uncomfortable for you.

There exists the possibility of certain changes occurring during the test. They include abnormal blood pressure, fainting, disorders of the heart beat, and very rare instances of heart attack. Every effort will be made to minimize them by the preliminary examination and by observations during testing. Trained personnel are available to deal with unusual situations which may arise.

The results obtained from the exercise test may assist in the diagnosis of illnesses or in evaluating what types of activities you might carry out with no or low hazards.

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

Permission for you to perform this graded 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 and I consent to participate in this test.

____
Signature of Patient

______________________________ ______________________________
Date Witness

LOMA LINDA UNIVERSITY

HUMAN PERFORMANCE LAB

Name ______________________________ Date ______________________

Age __________________ Max. Heart Rate (predicted) ______________

TREADMILL DATA

BRUCE PROTOCOL

	MIN	MPH	%GRADE
REST			
STG 1	3	1.7	10
STG 2	3	2.5	12
STG 3	3	3.4	14
STG 4	3	4.2	16
STG 5	3	5.0	18
STG 6	3	5.5	20
STG 7	3	6.0	22

RECOVERY	H R	B P		H R	B P
IMMEDIATE	___	_/_	6th MIN	___	_/_
2nd MIN	___	_/_	8th MIN	___	_/_
4th MIN	___	_/_	10th MIN	___	_/_

EX TIME ON TREADMILL _________________ MAX H R ___________________

RAW DATA

Subject	Dextrose Solution	Sugar-Free Kool-Aid
1	739 seconds	787 seconds
2	876	899
3	932	973
4	902	945
5	814	732
6	879	918
7	1092	1127
8	770	821
9	951	948
10	780	920
11	961	993
12	858	849
13	912	876
14	1011	1053
15	1109	1149
16	782	918
17	850	922
18	673	725
19	756	823
Total	16,647 seconds (14 min., 36 sec.)	17,378 seconds (15 min., 14 sec.)

Difference: 38.4 seconds