THE EFFECT OF MILK ON ATHLETIC ENDURANCE PERFORMANCE

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

Ernest Lee Smedley

1959

THE EFFECT OF MILK ON ATHLETIC ENDURANCE PERFORMANCE

by

Ernest Leo Smedley

AN ABSTRACT

Submitted to the College of Education of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirement for the degree of

MASTER OF ARTS

Department of Health, Physical Education, and Recreation

Year 1959

APPROVED 

ERNEST LEO SMEDLEY ABSTRACT

THE EFFECT OF MILK ON ATHLETIC ENDURANCE PERFORMANCE

Statement of the Problem

It is an important objective of researchers in the Physical Education field to supply coaches with valid information concerning technical aspects of coaching. Since it is usual for coaches to become very influential in shaping athletic practices, it is desirable that correct information should be available to them. Information concerning proper diet is essential to prevent the elimination of sound dietary items from training meals. This study proposes to investigate the validity of claims that milk impairs athletic performance. The study will test the effect of the inclusion and exclusion of milk and milk products in the diet on physical endurance.

Methodology

Nine Freshmen track candidates from Michigan State University participated in the experiment. Records were kept on body weight, basal metabolism, energy metabolism, and all-out-runs. The energy metabolism test was conducted on the motor-driven treadmill at a speed of six miles per hour at "0" degrees grade. The all-out-runs were also

conducted on the tread-mill at a speed of ten miles per hour at 8.6 percent grade. For the all-out-run the subjects ran to exhaustion, then their times were recorded in seconds. An analysis of variance was computed on gross oxygen debt, exercise oxygen intake, and all-out-runs.

Conclusions

1. The inclusion and exclusion of milk and milk products in the diets did not affect the endurance performance of either group. The evidence of the data presented indicates that milk does not hinder or benefit endurance performance.

2. The energy metabolism measures of gross oxygen intake and debt are not significantly affected by the inclusion or exclusion of milk or milk products in the diet.

THE EFFECT OF MILK ON ATHLETIC ENDURANCE PERFORMANCE

by

Ernest Leo Smedley

A THESIS

Submitted to the College of Education of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirement for the degree of

MASTER OF ARTS

Department of Health, Physical Education, and Recreation

Year 1959

ACKNOWLEDGEMENTS

The author wishes to extend his thanks to Dr. Wayne Van Huss for his interest and guidance in the preparation of this thesis.

Special thanks is also extended to Dr. Gale Mikles for his encouragement, suggestions, and assistance throughout the preparation of this paper. The writer is also indebted to Mr. Nye LaBaw for his cooperation and assistance in securing data for the study, and to Dr. Henry J. Montoye for his valuable suggestions.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

The belief that drinking milk impairs performance is quite common among athletic coaches. This belief is usually based on one or more of the following contentions:

1. Under the emotional tensions and strenuous physical effort associated with athletic competition, milk contributes to decreased salivary gland activity called "cotton mouth".[1]
2. When milk has been consumed within a few hours before competition, it does not digest properly, "curdles in the stomach," with resulting interference with maximum performance.[2]
3. Milk in the athlete's diet raises the fat intake. This results in a lower respiratory quotient during athletic endeavor. The raised oxygen

---

[1] R. M. Moose, "Does Milk Make Mucus?" California Medicine, 68:31-32, January, 1948.

[2] R. E. Brogdon, F. A. Hellebrandt, "Investigations of the Influence of Exercise Upon Digestion in the Stomach; The Effect of Swimming Upon the Acidity of the Gastric Juice," Research Quarterly, 5:52-62, May, 1934.

> requirement for a given amount of work prevents the attainment of top endurance performance.[3]

Although we know of no scientific evidence to support these contentions, we are also unaware of any controlled experiments which indicate that milk is beneficial to athletic performance.

Purpose of the Study

It is an important objective of researchers in the Physical Education field to supply coaches with valid information concerning technical aspects of coaching. Since it is usual for coaches to become very influential in shaping athletic practice,[4] it is desirable that correct information should be available to them. Information concerning proper diet is essential to prevent the elimination of sound dietary items from training meals.

This study proposes to investigate the validity of claims that milk impairs athletic performance. The study will

---

[3] E. H. Christensen, O. Hansen, "Work Capacity and Nutrition," Skardinavisches Archiv for Physiologie, 81:160-171, 1939.

[4] W. M. Staton, "Vitamin Nutrition for School boy Athletes," Scholastic Coach, 21:52, September, 1951.

test the effect of the inclusion and exclusion of milk and milk products in the diet on physical endurance.

CHAPTER II

REVIEW OF THE LITERATURE

In reviewing the literature concerning the relationship between diet and physical efficiency, the writer was unable to locate a scientific study dealing with milk and athletic performance. The information gathered by the writer does offer some light on the study and is presented in this writing.

Dr. H. C. Carlson[5] stated that: "Some superstitious coaches believe that milk, a so-called "heavy food" is bad for athletes."

In this article as well as many others milk is referred to as being bad for athletes without scientific evidence to support these statements. H. L. Upjohn[6] and others also referred to "old wives tales" in reference to athletes and milk.

---

[5]H. C. Carlson, "Care and Feeding of Athletes; A Medical Report," Newsweek, 41"102, March 23, 1953.

[6]H. L. Upjohn, J. A. Shea, F. J. Stare, and L. Little, "Feeding the Athlete," Scholastic Coach, 23:36, September, 1953.

In 1938 Bohm[7] in his "How Champions Train," reported that Johnny Kelly, an American Olympic contestant of 1936 made this statement: "I personally cannot stomach milk--it makes me ill." In the same article Bohm also reported that Boyd Comstock, coach of the 1936 Italian Olympic team stated: "Milk almost ruined one of my athletes and putting him back on wine and water made him OK."

The writer believes that these statements may have some bearing on the creation of the "old wives tales."

In contrast to the previous statements G. Z. Dupain[8] in his training diet for endurance performance, included four cups of milk daily. Dupain stated that this was to prevent a calcium deficiency. This is in agreement with Dr. Genevieve Sterns,[9] who stated: "American habits of diet make calcium deficiency a common defect of nutrition in this country."

The 1953 edition of Todays Health[10] stated: "Unfortunately, many food fads are followed by some of these who

---

[7] W. Bohm, "How Champions Train," Athletic Journal, 18:5, 1938.

[8] G. Z. Dupain, "Specific Diets and Athletic Fitness; a Prelimary Investigation," Research Quarterly, 10:33-40, December, 1939.

[9] Dr. Genevieve Stearns, "Lack of Calcium is Common Deficiency," Science Digest, 27:51, May, 1950.

[10] "Diet for Athletes," Todays Health, 31:4, February, 1953.

supervise diets of athletes. For example, some warn against the use of fluid milk without knowing why and without recognizing that milk is a good source of energy as well as calcium."

In relation to calcium deficiency, Steggerda and Mitchell[11] found that milk and milk solids supplied three fourths of the amount of calcium needed for body equilibrium. Staton[12] reported that milk is also an important source of Vitamin A, B-2, and D. With these facts in mind Lininger[13] stated that: "The influence of the addition of milk to the diet of school children is reflected in a definite increase in the rate of growth, both in height and weight."

---

[11] F. R. Steggerda, H. H. Mitchell, "Calcium Requirement of Adult Man and Utilization of Calcium in Milk," Journal of Nutrition, 17:243-262, March, 1939.

[12] W. M. Station, "Role of Vitamins in Athletic Performance," Scholastic Coach, 21:34, October, 1951.

[13] F. F. Lininger, "Relation of the Use of Milk to the Physical and Scholastic Progress to Undernourished School Children," American Journal of Public Health, 23"555-60, June, 1933.

CHAPTER III

METHODOLOGY

This study was undertaken to determine the relationship of milk on athletic endurance performance. Nine freshmen track men trained in endurance running were trained for one month in running on the motor-driven tread mill. They were then divided into two groups. One group of four subjects consumed diets containing three pints of milk daily and about two pints of ice cream per week. The other five subjects consumed no fluid milk or milk products. The period of observation was eight weeks.

Measurements

1. Basic measurements (repeated three times)
   a. skin fold fat measurements
   *b. blood serum cholesterol
   c. diet history and diet recall (daily for one week)
2. Daily measurements
   a. body weight
   b. basal metabolism (including respiratory quotient)

---

*Not necessary for experiment

c. electrocardiogram

d. energy metabolism during standardized steady state. strenuous running on the tread mill (measurements taken were instantaneous oxygen intake, respiratory quotient during and after the run, and oxygen debt.)

e. Two all-out runs per week under supervision. The subjects ran on the motor driven tread mill at a speed of 10 miles per hour at an incline of 8.6 degrees.

The subjects ran to exhaustion and their times recorded. The Dougless method of gas collection was utilized.[14] For carbon dioxide analysis, samples were collected over mercury in Bailey bottles. Carbon dioxide was analyzed using the Haldane-Henderson apparatus. Oxygen samples were taken from the Dougless bags in small rubber bags and analyzed immediately using a Beckmen E-2 Oxygen Analyzer. Repeat checks were maintained on the Beckmen by duplicate samples and Haldane analysis.

The steady state exercises were run on the Motor-driven treadmill at a speed of six miles per hour at "0" degrees grade. The all-out-runs were run at a speed of ten miles per hour at 8.6 percent grade.

The variables selected for analysis in the present

---

[14] K. Edam, "Practical Direction for Determination of Basal Metabolism According to Dougless-Haldane," Medicus Monatsschr, 7:791-796, December, 1953.

study were the exercise oxygen intake, gross oxygen debt, and the all-out-runs.[15, 16, 17] The analysis of variance technique was used for statistical treatment of the data as described by Goulden.[18]

---

[15] C. A. Knehr, D. B. Dill, and W. Neufeld, "Training and Its Effect on Man at Rest and At Work," American Journal Physiology, 136-148-156, 1942.

[16] Ibid.

[17] H. L. Taylor, E. Buskule, and A. Henschel, "Maximal Oxygen Intake as an Objective Measure of Cardiorespiratory Performance," Journal of Applied Physiology, 8:73-80, July, 1955.

[18] C. H. Goulden, Methods of Statistical Analysis. New York: John Wiley and Sons, Inc., 1952. p. 93.

CHAPTER IV

ANALYSIS AND PRESENTATION OF DATA

This study was undertaken in an effort to determine differences in athletic performance that could be attributed to the inclusion or exclusion of milk and milk products from the diet. The subjects were tested over an eight week period.

Results

Analysis of variance was used in the statistical analysis according to Goulden. The difference between the groups, weeks, individuals, and the groups' x weeks interaction were all tested. Since the experimental and control groups were formed by the random placement of subjects into the two groups (the groups were not evenly matched in the size sample used) a correct interpretation of these analyses is essential.

A statistically significant "F" between the two groups indicates either that the groups were different to start with, that the groups responded differently to the training, or that a combination of the two took place. The groups x the weeks interaction reflects the difference in the slopes

of the training curve of the two groups. If the response to training is different this interaction should be significant. The groups x weeks interaction is the critical statistic in this experiment due to the initial difference in groups in most of the variables. Therefore if the group statistic is significant and the difference is to be attributed to the experimental variable the groups x weeks interaction must also be significant. If it is not, the significance in the group statistics is attributable only to the initial difference in the groups. The weeks statistics reflect the changes taking place in both groups with training. Where significant, it merely means that the changes are not chance fluctuations but are real differences. The individual statistics were calculated because the individuals are different. The difference due to training, as the experimental variable, would necessarily have to be large. Pulling out the individual's variance permits a better examination of the experimental variable. The fact that all of the individuals' statistics were significant confirms this logic.

The all-out runs were used as one measure of athletic endurance performance. The subjects ran on the motor-driven tread-mill at a speed of ten miles per hour at an incline of 8.6 degrees. The subjects ran to exhaustion and their times

were recorded.

Table I contains the analysis of variance results for the all-out-runs. The groups, weeks, and the individual's statistics were statistically significant at the .01 level. The groups "F" may be accounted for by the fact that the subjects were not evenly matched at the start. The effect of the diet's (group x weeks) shows no statistical significance with an "F" of .57. An "F" of 7.31 is needed to be significant at the .01 level. The "F" values for the individuals were very high in all of the analyses. This may be attributed to differences in the levels of athletic abilities of the subjects tested.

TABLE I

ANALYSIS OF VARIANCE OF GROSS OXYGEN DEBT, EXERCISE OXYGEN INTAKE, AND ALL-OUT-RUNS

*	Gross Oxygen Debt	Exercise Oxygen Intake	All-Out Runs
Groups	.16	2.25	19.41**
Weeks	1.57	1.75	7.48**
Individuals	12.81**	11.0**	105.27**
Groups x Weeks	.60	1.25	.57

**P = .01

*Subtracted degrees of freedom according to W. P. Baten, "Formulas for Finding Estimates For Two and Three Missing Plots in Randomized Block Layouts," Michigan State College Agricultural Experiment Station, Technical Bulletin 165, April, 1939.

The exercise oxygen intakes were used as a measure of the athlete's ability to pull oxygen (needed for endurance performance) out of the air.

Table I contains the analysis of variance for the exercise oxygen intake. Again it was found that the individuals were significant at the .01 percent level, with an "F" of 11.0. Here we also find that the effect of the diets (group x weeks) shows no statistical significance with an "F" of 1.25.

The gross oxygen debt was used as another measure of athletic endurance performance. Table I contains the analysis of variance for the gross oxygen debt. Again it was found that the individuals were statistically significant at the .01 percent level with an "F" of 12.81. The effect of the diets however (group x Weeks) was not statistically significant.

The following observations may be made relative to the analysis of variance of the three variables.

The individual's statistics were all significant at the .ol percent level of confidence. This suggests that the individuals are different in their athletic endurance performance capacities. In no case did the author find statistical significance in the milk and non-milk diets.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Nine freshmen track candidates were selected from the Michigan State University freshmen track team to participate in this experiment. The purpose of the study was to determine the relationship of the inclusion and exclusion of milk and milk products in the diet on physical endurance performance.

Conclusions

The following conclusions seem justified on the basis of the statistical data presented.

1 The inclusion and exclusion of milk and milk products in the diets did not affect the all-out endurance performance of either group. Milk does not hinder endurance performance, however the evidence presented also does not indicate that milk is beneficial to athletic endurance performance.

2. The energy metabolism measures of gross oxygen intake and debt are not significantly affected by the inclusion or exclusion of milk and milk products in the diet.

Recommendations

The following recommendations are made as a result of this study.

1. A similar investigation using a large number of high school subjects may give more light on the subject.

2. A study on the psychology of endurance running may give us more insight on this important aspect of training.

3. A study involving the overload principle of training using a motor-driven tread-mill as the training device might prove to be invaluable to coaches.

BIBLIOGRAPHY

A. BOOKS

C. H. Goulden. Methods of Statistical Analyses. New York: John Wiley and Sons, Inc., 1952. p. 93.

B. PERIODICALS

Bohm, W. "How Champions Train," Athletic Journal, 18:5, 1938.

Brogdon, R. E., Hellebrandt, F. A. "Investigations of the Influence of Exercise Upon Digestion in the Stomach; The Effect of Swimming Upon the Acidity of the Gastric Juice," Research Quarterly, 5:52-62, May, 1934.

Daniels, A. L. "Relation of Milk Ingestion to Calcium Metabolism," Society for Experimental Biology and Medicine, Proceedings, 30:1062-1063, 1933.

Christensen, E. H., Hansen, O., "Work Capacity and Nutrition," Skandinavisches Archiv for Physiology, 81:160-171, 1939.

Christensen, E. H., Hogberg, P. "Steady State, 02 Deficit and 02 Debt at Severe Work," Arbeitsphysiologie, 14:251-254, 1950.

Dupain, G. Z., "Specific Diets and Athletic Fitness, A Preliminary Investigation," Research Quarterly, 10:33-40, December, 1939.

Knehr, C. A., Dill, D. B., Neufeld, W. "Training and Its Effect on Man at Work and At Rest," American Journal Physiology, 136:148-156, 1942.

Lininger, F. F. "Relation of the Use of Milk to the Physical and Scholastic Progress of Undernourished School Children," American Journal of Public Health, 23:555-60, June, 1933.

Miller, A. T., Blyth, C. S. "Influence of Body Type and Body Fat content on Metabolic Cost of Work," Journal of Applied Physiology, 8:139-141, September, 1955.

Moose, R. M. "Does Milk Make Mucus?" California Medicine, 68:31-32, January, 1948.

Rosenberg, L. C., Rogers, F. R. "Study of the Effect of Two Diets on Physical Powers," Research Quarterly, 6:257-62, March, 1935.

Sperling, G. "Effect of Long Time Feeding of Whole Milk to White Rats," Journal of Nutrition, 55:399-414, March, 1955.

Stearns, G. "Lack of Calcium Is Common Deficiency," Science Digest, 27:51, May, 1950.

Staton, W. M. "Vitamin Nutrition for School Boy Athletics," Scholastic Coach, 21:52, September, 1951.

Staton, W. M. "Role of Vitamins in Athletic Performance," Scholastic Coach, 21:34, October, 1951.

Steggerda, F. R., Mitchell, H. H. "Calcium Requirements of Adult Men and Utilization of Calcium in Milk," Journal of Nutrition, 17:253-262, March, 1939.

Taylor, H. L., Buskul, E., Henschel, A. "Maximal Oxygen Intake as Objective Measures of Cardiorespiratory Performance," Journal of Applied Physiology, 8:73-80, July, 1955.

Upjohn, H. L., J. A. Shea, F. J. Stare, and L. Little. "Feeding the Athlete," Scholastic Coach, 23:36, September, 1953.

Upjohn, H. L., J. A. Shea, F. J. Stare, and L. Little. "Nutrition of Athletes; Council on Foods and Nutrition," Journal of the American Medical Association, 151:818-819, March, 1953.

C. ARTICLES

Carlson, H. C. "Care and Feeding of Athletes; A Medical Report," Newsweek, 41"102, March 23, 1953.

Chittenden, R. H. "Influence of Diet on Endurance and General Efficiency," Popular Science, 71:536-41, December, 1907.

_____ "Diet for Today's Athletes," Todays Health, 31:4, February, 1953.

~~JUL 2 01987~~

K-337