NUTRITIONAL KNOWLEDGE AS IT RELATES TO PHYSICAL FITNESS OF UNDERGRADUATES ENROLLED IN A BASIC HUMAN NUTRITION COURSE

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CHAPTER I

INTRODUCTION

Disease prevention and health promotion have become prime concerns of many Americans. This interest in preventive health has renewed an awareness in nutrition and physical fitness as two important factors contributing to good health (HEW, 1979).

Various reasons support the growing concern with preventive health measures in the United States. Chronic diseases including coronary heart disease, hypertension, colon cancer and diabetes mellitus have been linked to the American diet. Obesity has become the nation's major nutritional problem (Kreutler, 1980). As health care costs escalate, both the private individual and industry seek cost reductions through health maintenance measures (Tolbin, 1980). And, with the continued popularity of American sports and our society's emphasis on the "fashionable look of thin", both nutrition and physical fitness have facilitated many of these individuals in acquiring their desired goals.

According to Hunt (1978), participants in physical fitness activities and athletics are interested in nutrition; and its relationship with physical fitness in

maintaining good health. A concern of individuals, who participate in physical fitness and athletics, centers on the role of nutrition in improving human performance.

Within the area of nutrition and physical fitness, ignorance, misconceptions, and fallacies frequently obscure scientifically based nutrition principles (Smith, 1976; Higdon, 1978). Scientific research has provided information about the nutritional knowledge of certain sampled populations (Dwyer, Feldman, and Mayer, 1970; Petersen and Kies, 1972; Cho and Fryer, 1974; Krause and Fox, 1977; Shannon, Marbach, Graves, and Sims, 1981). According to a review of the literature, few research studies have been initiated that determine nutritional knowledge as it relates to physical fitness. Such research could assist in pinpointing current areas of ignorance and misconceptions in the area of nutrition related to physical fitness. This information would also be valuable in nutrition education planning for a variety of professional groups which deal with the topics of nutrition, health and fitness. These professionals might include dietitians, nutritionists, home economists; health and physical education educators; athletic coaches and trainers; and fitness coordinators and directors.

The purpose of this study was to determine the nutritional knowledge as it relates to physical fitness of undergraduate students enrolled in a basic human nutrition course at Oklahoma State University. Specific objectives for this study were:

1. To identify demographic characteristics and background information of the subjects.
2. To identify the sources of nutrition information used by the subjects.
3. To determine the "perceived", "accurate", and "correct" nutrition knowledge scores of the subjects.
4. To determine any differences in the mean nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.
5. To make recommendations for program planning in nutrition as it relates to physical fitness.

Hypotheses

The three hypotheses postulated for this study were:

1. Hypothesis One: There will be no significant difference in the mean "perceived" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.
2. Hypothesis Two: There will be no significant difference in the mean "accurate" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

3. Hypothesis Three: There will be no significant difference in the mean "correct" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

Each of the preceding hypotheses in actuality is comprised of four separate hypotheses.

Assumptions

The assumptions for this study were:

1. The undergraduates responded to the research instrument honestly.
2. The research instrument was valid.
3. Nutritional knowledge and dietary practices positively correlate.
4. Physical fitness participation results in increased nutrition knowledge.

Limitations

The limitations for this research were:

1. The sample was limited to undergraduate students enrolled in a basic human nutrition course at Oklahoma State University, Fall semester 1983.
2. The sample was limited to undergraduate students who had no previous human nutrition course at the college level.

Definitions

Definitions of terms used in this research were:

1. Nutrition: "Nutrition is the science of food, the nutrients and other substances therein, their action, interaction, and balance in relation to health and disease, and the processes by which the organism ingests, digests, absorbs, transports, utilizes, and excretes food substances. In addition, nutrition must be concerned with social, economic, cultural, and psychological implications of food and eating" (Arkwright, Collins, Sharp, and Yakel, 1974, p. 661).
2. Nutritional Knowledge: A state of awareness and understanding of nutrition gained through study and learning experiences.
3. Undergraduate: A student enrolled at a college or university who has not officially completed the academic requirements of a bachelor's degree.
4. Physical Fitness: The ability to meet all the ordinary daily physical demands on the body without becoming tired, and also being able to respond to extra demands when necessary.
5. Athlete: Any individual who physically participates on a regular basis (at least three or more times a week for a continuous time interval of 20 or more minutes) in a physical fitness activity,

exercise, game, or sport for reasons of health, leisure, social, or competitive nature.

6. Athletics: "Games, exercises and sports requiring physical ability and usually some measure of adroitness" (Salak, 1961, p. 16).
7. Misconception: A belief considered true which may be based on a misunderstanding or an incorrect interpretation and lacks supportive scientific evidence.
8. Fallacy: An incorrect or false idea.
9. Nutrition Education: "The process by which beliefs, attitudes, environmental influences, and understanding about food lead to practices that are scientifically sound, practical, and consistent with individual needs and available food sources" (ADA, 1978, p. 302).
10. Perceived Knowledge: The belief by an individual that he or she possesses certain factual knowledge (which may include fallacies and misconceptions) about a specific topic. (Refer to Chapter III, p. 53).
11. Accurate Knowledge: The actual knowledge an individual possesses in comparison to their perceived knowledge on a specific topic which eliminates fallacies, misconceptions, and areas of ignorance. (Refer to Chapter III, p. 53.)

12. Correct Knowledge: The factual knowledge an individual possesses on a specific topic which distinguishes the truth from fallacies and misconceptions. (Refer to Chapter III, p. 53.)

CHAPTER II

REVIEW OF THE LITERATURE

In the 1980's, the American people have renewed an interest in improving their health not only through medical care but also through an emphasis in preventative health care. This interest in disease prevention and health promotion has brought attention to both nutrition and physical fitness as vital components of preventative health (HEW, 1979). A review of literature was conducted to obtain information regarding nutrition as it relates to physical fitness and encompassed the areas of current dietary trends in America, the role of physical fitness, nutritional guidelines for human performance, studies of nutritional knowledge, and nutrition education.

Trends in the American Diet

Introduction

With the publication of the Dietary Goals for the United States (Senate Select Committee, 1977), American citizens became aware of the fact that their present dietary habits were unhealthy. The American diet, characterized by food high in calories, sugars, fats, cholesterol, and salt, was identified with coronary heart disease, hypertension,

obesity, diabetes mellitus, stroke, breast and colon cancers, and dental caries (Senate Select Committee, 1977; Kreutler, 1980). The controversy and notriety attributed to the Dietary Goals for the United States (Senate Select Committee, 1977) helped stimulate a nutritional concern among American consumers regarding healthier dietary habits. Thus, food consumption patterns emerged in the United States in which some consumers sought to select their foods based on health-related reasons (Jones and Weimer, 1980 and 1981).

U.S.D.A. Economics and Statistics Service Survey

In 1979, the United States Department of Agriculture (USDA) Economics and Statistics Service conducted a survey (Jones and Weimer, 1981). This survey revealed that 64 percent of the households (1,353) reported dietary changes in the past three years for health, nutrition, or safety reasons. Many households were concerned with reducing their intake of sugar, salt, fat and cholesterol. Weight control and high blood pressure were two other major health concerns.

Participants reported the following changes in their food habits a) reduced consumption of bacon, sausage, luncheon meats; whole milk; butter; white flour; refined sugar; b) increased consumption of poultry, fish, shellfish; low fat milk; vegetable oils and soft margarines; whole

grains; fruits and vegetables; and, c) decreased consumption of salty foods and soft drinks.

Nationwide Food Consumption Survey

Information comparing the USDA's 1965 Food Consumption Survey (FCS) and the 1977 Food Consumption Survey (FCS) revealed that Americans were eating better in 1977 than in 1965 (Cronin, Pao, and Hama, 1980). Calorie intakes were lower in 1977 than in 1965 for all 22 sex-age groups and averaged 15 percent below the Recommended Dietary Allowances (RDA) (Food and Nutrition Board, 1980). Total caloric composition in 1977 averaged 16.6 percent from protein; 40.3 percent from fat; and 42.8 percent from carbohydrate.

Average body weights for individuals in 1977 were similar to the 1965 body weight averages (Cronin, 1980). A reduction in calories, however, had not resulted in an associated weight loss which may be due to an increasingly sedentary lifestyle (Pao, 1980).

Further data from 1977 FCS (USDA, 1980) indicated that fat intakes decreased from 1965 for all sex-age groups. Yet, all sex-age groups consumed above the American Heart Association's recommended level of 35 percent of calories or less (Rizek and Jackson, 1980).

For most of the sex-age groups, nutrient intakes for protein, thiamin, riboflavin, niacin, vitamins A, B, and C, and phosporous met the RDA (Food and Nutrition Board, 1980). The RDA (Food and Nutrition Board, 1980) for calcium

consumption was met only for children under three years, and six to eight years, and for males 19 to 34 years.

Iron intakes for infants in 1977 averaged 100 percent or more of the RDA (Food and Nutrition Board, 1980), as well as for most school-age children and men. Iron intake for females 12 to 50 years of age were significantly below the recommended levels (Food and Nutrition Board, 1980). Intakes of B_6 and magnesium were less than 100 percent of the RDA (Food and Nutrition Board, 1980) for all sex-age groups over two years of age and especially low for females.

Household Food Supply

According to Cronin (1980), the changes in the average nutrient levels between 1965 and 1977 reflected the differences in the types of food consumed by the American household. The consumption of milk and milk products decreased by five percent and was reflected in the decreased levels of dietary calcium. Meat, poultry and fish plus other high-protein foods (beans, nuts, eggs) basically remained stable in the amount consumed. The consumption of beef, poultry, fish and nuts increased while the quantity of pork (including salt pork and bacon), luncheon meat, eggs, and dry beans decreased in usage.

The reduction in vegetable consumption by households was primarily due to decreased usage of potatoes (Cronin, 1980). Consumption of dark green vegetables rose resulting in higher levels of vitamins A, C, B_6, folacin and the

mineral, magnesium. Vitamin C increased significantly with an increased consumption of citrus fruits, green vegetables, and fortified drinks.

Even though bread and cereal usage decreased between 1965 and 1977, there was not a decrease in the levels of thiamin, preformed niacin and riboflavin. This was probably due to the fact that these nutrients were increased in the enrichment process of flour and breads in 1975. Secondly, unenriched bread and cereal products consumption declined from 21 percent in 1965 to only five percent in 1977.

A major change occurring in the household food supply between 1965 and 1977 was the decrease in the energy content of the foods selected (Cronin, 1980). Calories from some carbohydrate foods decreased significantly. There was a decline in the consumption of breads, cereals, milk products, sugar, syrup, jelly, and candy, but not in soft drinks, punch and sugary desserts. The decreased household consumption of fats, oils and milk products, as well as, bacon and luncheon meats, resulted in a decrease of total fat in the American diet.

Several changes occured in beverage consumption. The consumption of coffee was down in 1977 while tea intake was up. With the additional selections of diet or caffeine free, soft drink consumption, both carbonated and noncarbonated, increased significantly since 1965. Both Pao (1980) and Prescott (1981) reported similar changes in the American food consumption patterns.

Nutrient Content of the American Food Supply

In America, the nutrient content of our national food supply continues to shift. The 1980 nutrient levels according to Marston and Welsh (1981) for food energy and 12 nutrients were one to 17 percent higher than in 1967.

The ascorbic acid level was 17 percent higher largely due to the popularity of fortified fruit juices. Thiamin, niacin, and riboflavin increased due to enrichment and increased consumption of poultry and pork.

Nutrient levels for protein, iron, magnesium, vitamins B_6 and B_{12} increased above their 1967 levels. This increase was influenced by the rise in the consumption of pork, poultry, and enriched grains. A higher consumption of processed tomato products, poultry, and liver affected the rise in the vitamin A level.

The fat level increased from 1967 by 10 percent due to the rise in salad and cooking oil consumption (Marston and Welsh, 1981). With the popular commercial use of high fructose corn syrups, the carbohydrate intake was also elevated. The 1980 caloric intake was up nine percent from 3,240 kilocalories to 3,520 kilocalories per capita consumption per day.

Calcium, the only declining nutrient since 1967, dropped. The reduced consumption of fluid whole milk and nonfat dry milk facilitated the decreased calcium intake.

Nutritional Guidelines in the United States

In 1976, approximately 50 percent of the United States mortality was due to unhealthy behavior or lifestyle (HEW, 1979). Improvement in the health of Americans involves not only the treatment of disease, but also preventive measures (Jones and Weimer, 1980). Good habits based partly in nutritional knowledge promote health and the quality of life; and play a role in preventive health measures.

In order to meet the health concerns of the American consumer regarding diet and food habits and to clarify the Dietary Goals (Senate Select Committee, 1977), scientists from the USDA and the United States Department of Health and Human Services (HHS) developed a set of guidelines. A booklet entitled, Nutrition and your Health: Dietary Guidelines for Americans (USDA-HHS, 1980) was published for the lay public. It consisted of the following seven dietary recommendations:

1. eat a variety of foods,
2. maintain ideal weight,
3. avoid too much fat, saturated fat, and cholesterol,
4. eat foods with adequate starch and fiber,
5. avoid too much sugar,
6. avoid too much sodium, and
7. if you drink alcohol, do so in moderation.

The booklet's emphasis was on selecting a variety of foods which maintain ideal weight and avoid excess

consumption of certain nutrients. The booklet also presented information of the relationship of fat, saturated fats, cholesterol, sugar, sodium, fiber and alcohol to specific diseases and physical conditions.

A further recommendation from the dietary guides (USDA-HHS, 1980) involved the role of physical fitness in maintenance of ideal weight. It was suggested that daily physical activitites be gradually increased to aid in weight loss. Thus, the combination of proper nutrition and physical activity promote a healthier lifestyle.

Physical Fitness

Current Trends

The number of Americans participating in various physical fitness activities and exercises has increased rapidly during the last decade. Many of these individuals who have lived sedentary lifestyles are becoming involved in physical exercise for the first time in their lives (Morehouse, 1981). This new surge of interest in fitness has encouraged millions of Americans to engage in activities such as running, swimming, tennis, bicycling as well as other types of sports and exercises (HEW, 1979). A Gallup Poll survey in 1977 revealed that approximately 50 percent of the adults said they were regularly exercising to maintain fitness. A more recent survey (Butwin, 1981) reported that 81 percent of the respondents recognized the value of exercise to good health; however, 55 percent stated that they considered

themselves to be nonregular exercisers. Of the 45 percent who regularly exercised, one third had initiated their exercise programs within the last two years.

Several professional organizations, the American Heart Association, American College of Sports Medicine, American Alliance for Health, Physical Education and Recreation, and American School Health Association, support the American public's effort to become more active and physically fit (Pollock, 1979). Exercise and physical fitness are invaluable factors needed in changing the current sedentary lifestyle to one which exemplifies a healthier state of living.

Definition of Fitness

Physical fitness encompasses a wide range of definitions. Physical fitness, as described by the President's Council on Youth Fitness (Schifferes and Peterson, 1972)

> is a broad quality involving medical and dental supervision and care, immunization and other protection against disease, proper nutrition, adequate rest, relaxation, good health practices, sanitation, and other aspects of healthful living. Exercise is an essential element to achieve physical fitness. Strength, stamina, endurance, and other desirable physical qualities are best developed through physical activity . . . (p. 112).

Physical fitness is a dynamic quality of life which can lead Americans to a more healthful and productive lifestyle (HEW, 1979; Pollock, 1979).

Fitness Benefits

Physical fitness offers a wide range of health-related benefits. Physical exercise promotes the development and maintenance of bone tissue, muscular strength and flexibility, and working capacity (Pollock, 1979). Another health-related benefit deals with reducing the risk against cardiovascular diseases, obesity, and other degenerative diseases (Fall, Baylor and Dishman, 1980).

According to Healthy People, The Surgeon General's Report on Health Promotion and Disease Prevention (HEW, 1979), Americans who regularly participate in exercise report that they have increased energy, need less sleep, and feel better. Excess body weight if caloric consumption is controlled is lost, as well as, improved strength and flexibility of the muscles with consistent exercise. Psychological benefits include improved self image, and relief of tension, anxiety and depression.

Further information from HEW (1979) indicates that the best exercise for promoting cardiovascular health is aerobic exercise for it requires large amounts of oxygen for energy. Aerobic exercise entails 15 or more minutes of continuous activity with the participant exercising at least three times a week. When exercisers were compared with nonexercisers, research has shown that exercisers have one and a half to two times lower risk of developing heart disease. Aerobic exercise has also been found to be beneficial with

patients with asthma, hypertension, chronic obstructive lung disease, and diabtetes mellitus.

A secondary aspect of physical fitness involves fitness benefits gained from participation in games, sports, and athletics (Getchell, 1979). Participation in athletics, sports, and games requires at least a minimum degree of physical fitness (Schifferes and Peterson, 1972). The type of sport or athletic activity, the level of skill, the activity's intensity, and the regularity in which an individual participates are all factors which affect the possible fitness benefits (Getchell, 1979). La Place (1976) recommends that a physical fitness program be founded upon a sport due to the advantages of motivation and continued participation because of the individual's personal interest. Two additional advantages of a sports-based fitness program are companionship and competition. Bartley (1976) and Getchell (1979) support the belief that sports should supplement basic fitness conditioning or a physical fitness program.

Nutritional Guidelines for Human Performance

Introduction

It is generally recognized that optimal nutrition is a basic component for developing and maintaining top physical performance (Hecker, 1982). With the renewed involvement in physical fitness by Americans (HEW, 1979) and the continued

popularity of athletics, an interest has been stimulated in nutrition and its effect on improving health and performance (Hunt, 1978; Worthington-Roberts, 1981). While self-discipline, training, and natural abilities are the primary means of achieving top physical performance, proper nutritional conditioning must also be continuously maintained to provide energy and meet the nutrient needs of the physical fitness participant (Hecker, 1982). For most active individuals, it is recommended that a nutritionally complete diet be consumed which is based on the basic four food groups inclusive of adequate nutrients, water, and calories to meet energy needs (Huse and Nelson, 1977; ADA, 1980; National Dairy Council, 1980).

Basic Nutritional Needs

For the training and competing athlete and physical fitness participant, the diet is basically the same as the average sedentary American's diet with the exception of calories due to the increased activitiy (Huse and Nelson, 1977; Smith, 1976) and water (ADA, 1980; National Dairy Council, 1980). A nutritionally balanced diet provides sufficient quantities of energy, water, protein, fat, and carbohydrate, as well as, minerals and vitamins in appropriate proportions (National Dairy Council, 1980). The athlete's dietary needs can be met by following the guidelines set forth by the Food and Nutrition Board of the National Academy of Sciences (1980) in the recommended

Dietary Allowances (American Alliance for Health, Physical Education, and Recreation (AAHPER), 1971), as well as, using the basic four food groups (Smith, 1976; National Dairy Council, 1980; Katch and McArdle, 1983).

Total caloric composition for an athlete's diet is obtained from a daily food intake which consists of 15 percent protein, 30 to 35 percent fat, and 50 to 55 percent carbohydrate (Nelson, 1975; Vitousek, 1979). For certain athletic events of endurance, a diet composed of 50 to 70 percent complex carbohydrate has been effective in improving human performance (Williams, 1976; Katch and McArdle, 1983). The daily total caloric intake varies for each athlete depending on body size and energy needs required by the specific sport (AAHPER, 1971; Katch and McArdle, 1983). Daily caloric levels range from 3,000 to 6,000 kilocalories according to Short and Short (1983) with research indicating mean caloric levels for athletes considerably above levels reported in traditional nutrition texts. To meet the increased energy requirements of the training and competing athlete, foods should be selected from the "calorie-plus-nutrients" types of foods (ADA, 1980). Special emphasis on increasing the intake of complex carbohydrates by chosing foods from the bread-cereal and fruit-vegtable groups should be encouraged.

Protein

Protein needs of the athlete can be met by consuming a

variety of foods from the basic four food groups. Increased physical activity does not require additional protein in the diet (Worthington-Roberts, 1981). Muscle mass is increased only through appropriate training and conditioning (AAHPER, 1971; Katch and McArdle, 1983). A study by Astrand (1967) revealed that protein utilization did not significantly differ on days of inactivity from days which involved vigorous exercises. Therefore, the daily protein requirement recommended by the Food and Nutrition Board of the National Academy of Sciences (1980) of 0.8 g/kg of body weight for the adult should provide for the dietary needs of the adult athlete. For the pre-teen and adolescent athlete, 1 - 1.5 g/kg of body weight has been recommended to meet the demands of growth and maintenance (AAHPER, 1971). Lincoln (1979) reports that the protein requirement for the athlete is approximately 1 g/kg of body weight, depending on whether the athlete is still growing. A diet which provides 15 percent of the calories for protein should adequately meet the athlete's needs (Vitousek, 1979). The typical American mixed diet often provides more protein than is necessary (Worthington-Roberts, 1981; Katch and McArdle, 1983).

Energy Nutrients

Carbohydrates and fats are the two major sources of energy for physical activities (Serfass, 1978; Haskell, Scala, and Whittam, 1982). Astrand (1967) indicated that dietary fat supplied 50 to 60 percent of the energy needed

by the participants involved in light to moderate aerobic exercises. For vigorous anaerobic exercises, studies revealed that carbohydrate is the major source of energy (Astrand, 1967). Results of research have indicated that different diets affect glycogen storage in the muscles (National Dairy Council, 1975). With an increase in the glycogen stores of the muscles, the performance is improved. A dietary practice, carbohydrate-loading or glycogen-loading, is used to increase muscle glycogen storage above normal and improve performance in endurance type events of marathon running, or long-distant cycling, swimming, or cross-country skiing (Moore, 1981; Katch and McArdle, 1983). Performance in short term events has not benefited from the carbohydrate-loading regimin.

The carbohydrate-loading procedure, initiated one week before the athletic event, consists of depleting the muscles of glycogen stores through exhaustive exercises for approximately three days while on a high fat, high protein, low carbohydrate (100 grams daily) diet (Astrand, 1967). For the remaining days of the week, a high carbohydrate diet (50 to 70 percent) with adequate protein and fat is consumed with a reduction in exercise or no exercise (Forgnac, 1979) to spare glycogen reserves.

The form of carbohydrate consumed by the athlete during this procedure does not make any difference to the rate or quantity of glycogen stored (Costill, 1978). Complex carbohydrates such as whole grain breads and cereals and beans,

vegetables, and fruits may be the preferred form for carbohydrate-loading over simple carbohydrates as they produce a longer lasting insulin stimulation and blood glucose elevation (Costill, 1978; Haskell, Scala, and Whittam, 1982). Complex carbohydrates also offer additional vitamins and minerals which the simple carbohydrates do not (ADA, 1980).

Williams (1976) recommends that the glycogen-loading procedure be used only two or three times a year for special competitive events, e.g. long distance running, cycling, swimming. One disadvantage of carbohydrate-loading is the retention of water held with the stored glycogen causing sensations of heaviness and stiffness. The athlete's performance may be hindered by the additional weight of water. Mirkin (1973) reported a case where a marathon runner developed cardiac abnormalities after following a carbohydrate-loading practice. The use of the complete carbohydrate-loading procedure with young children is not recommended (Hecker, 1982) and should be used under careful supervision with the pre-teen (Smith, 1976). More research is needed to determine the effects of the carbohydrate-loading diet on the human body (Moore, 1981).

Vitamins and Minerals

Current evidence indicates that the vitamin and mineral needs of the performing athlete can be met by consumption of a properly balanced diet inclusive of a wide variety of food

(Huse and Nelson, 1977; Vitousek, 1979; Hecker, 1982; Haskell, Scala, and Whittam, 1982). Scientific research has not been able to prove that a vitamin intake above the RDA (Food and Nutrition Board, 1980) benefits an athlete's performance (Williams, 1976; Hecker, 1982). Toxic effects have been associated with the excessive consumption of the fat-soluble vitamins A, D, K, and E (Williams, 1976) and with vitamin C and niacin (Huse and Nelson, 1977). Other adverse effects have been reported with over consumption of vitamin B_6, folic acid; and B_{12} (Hecker, 1982).

Sodium, potassium, and iron are the minerals most frequently affected by strenuous physical activities or an inadequate dietary intake (Serfass, 1978). Both the sodium and potassium requirements can be met through the liberal salting of table foods and the inclusion of potassium-rich foods such as bananas, oranges, and potatoes. Use of salt tablets is not recommended since they may result in digestive disturbances due to rapid fluid movement into and out of the gut (ADA, 1980).

Short and Short (1983) reported a low intake of vitamin A, potassium and iron by the athletes. Clement and Asmundson (1982) revealed that long distance runners have an above normal frequency of latent iron deficiency and noted that the female runners had an insufficient intake of dietary iron. Hecker (1982) suggests that female athletes with heavy menstrual losses, supplement their diets with extra iron after first consulting a physician. Female

athletes using intrauterine contraceptive devices which increase menstrual bleeding are at risk of iron deficiency (Smith, 1976). Adolescent males from low income families are also nutritional risks of iron deficiency (Smith, 1976). Lane (1978) recommends that the daily potassium intake of acclimatized athletes performing in hot climates may need to be greater than 3.0 grams per day to replace losses from sweating.

Vitamin and mineral supplementation may be necessary for some athletes. Conditions which may require supplementation are a) regular consumption of a nutritionally poor diet; b) unusual dietary habits; c) a strict weight-loss program; and d) clinical diagnosis of a dietary deficiency (Williams, 1976 and Hecker, 1982).

Water

According to Hecker (1982), water is a most vital nutrient for optimal performance by the athlete. Physical work capacity of an individual is significantly limited by dehydration (National Dairy Council, 1980) and may result in hyperthermia and heat stroke (Vitousek, 1979). Special concern for adequate hydration is indicated for athletes training and competing in hot climates (Hanley, 1979).

Since thirst is not an accurate indicator of the need for fluids due to stress and tension associated with competition, it is recommended that all athletes weigh themselves before and after training and competition

sessions in order to adequately replace fluids lost (Smith, 1976). The American Alliance for Health, Physical Education, and Recreation (1971) has suggested that the athlete replace fluid losses hour by hour by frequent water intake. Scientific evidence does not support the restriction of water consumption by athletes (National Dairy Council, 1975; Morella and Turchetti, 1982). Fluids are to be encouraged before, during, and after physical activities according to the American Dietetic Association (1980) with possible forced drinking to maintain a well hydrated state.

Water is the most important item to replace in sweat losses and should be cold, hypotonic, and consumed in small amounts (150 to 250 milliters) at every 10 to 15 minute interval (Higdon, 1978). Replacement drinks containing a dilute sugar content (2.0 to 2.5 grams per 100 milliters of water) rapidly leave the stomach and assist in providing carbohydrate for energy. Other guidelines determined by Costill and co-workers (Higdon, 1978) include: a) drinking 400 to 600 ml of water before the competitive event; and b) after the competitive event, a conscious effort by the athlete should be made to consume a meal and drink plenty of fluids to replace fluid losses and electrolytes. Katch and McArdle (1983) suggest that cool, plain water be consumed before and during exercise as the best method of avoiding dehydration.

Pre-Event Meal

Much controversy centers around the athlete's pre-event meal. It should be recognized that sound nutritional practices throughout training and competition lead to optimal nutrition (Hecker, 1982). Certain types of foods may be limited or avoided in the pre-game meal to prevent digestive disturbances, such as, gas-formers, fatty foods, bulky foods, spicy ingredients and alcohol depending on the athlete's tolerance (AAHPER, 1971).

With the emotional stress and tension often involved with competition, the pre-event meal and its foods are very important nutritional aspects to the athlete (AAHPER, 1971). The strategy of the pre-event meal deals with the fact that the stomach should be empty when competing in order to prevent digestive disturbances of nausea, vomiting, cramps, or bloating (ADA, 1980). According to the American Alliance for Health, Physical Education, and Recreation (1971) and Katch and McArdle (1983), the main concern for the pre-event meal is that it be eaten at a reasonable time before the athletic event, about three hours so that the meal will be digested and absorbed by the body. Hecker (1982) states that a heavy pre-game meal should be consumed about four or five hours before game time, while a light pre-game meal of carbohydrate foods should be eaten three hours prior to the event. Morella and Turchetti (1982, p. 122) suggests "not to eat less than three hours before the event." The American Dietetic Association (1980) recommends a three to

four hour time period before training or competing for the pre-event meal. Smith (1976) suggests that the composition of the pre-event meal be high in carbohydrates and eaten up to two to two and a half hours before the competition.

Further guidelines for pre-event meal planning are 1) foods selected should be easily digested and absorbed allowing for an empty stomach at competition time to avoid digestive disturbances; 2) adequate energy intake should be provided to avoid feelings of hunger or weakness during the training session or athletic event; 3) optimal hydration should be insured through adequate fluid intake before, and during the competition; 4) avoid gas-producing foods that are problems for the athletes; and, 5) familiar foods should be served in the meal, especially those foods the athlete feel "will make him win" (Smith, 1976; Worthington-Roberts, 1981).

The composition and/or size of the pre-event meal has minimal influence on improving performance; a nutritionally balanced meal should be eaten by the athlete (Huse and Nelson, 1977). The use of some protein, a generous portion of carbohydrate, and limited fat should be included in the pre-game meal (ADA, 1980). According to Nelson (1982, p. 63), the athlete's best pre-game meal "depends on personal preferences, time of eating, and the type of event . . . . A normal well-balanced meal for the athlete is the best choice."

Weight Control

By combining appropriate diet and physical activities, the physical fitness of an individual can be enhanced. One specific aspect of achieving and maintaining optimal physical performance is weight control. A recommendation by the American Dietetic Association (1980) concedes that proper weight control be achieved through a program consisting of diet and behavior modification with regular participation in aerobic physical activity. It is also suggested that "body composition" is a better indicator of leaness than body weight; therefore, skinfold measurements should be utilized in determining an individual's body fat (Haskell, Scala and Whittan, 1982).

A nutritional concern with weight-control sports, such as, wrestling, boxing, and gymnastics is to balance the nutritional intake with sufficient fluids and maintain a desirable body weight for competing in a particular sport (Hecker, 1982). Common weight control techniques frequently practiced by athletes include use of diuretics, self induced vomiting, laxative usage, and semi-starvation (Hecker, 1982), as well as, sweat baths, water restriction, and "crash diets" (AAHPER, 1971). Such practices are dangerous to the athlete's health, reduce muscle strength, and impair the body's ability to regulate heat.

A successful weight control program according to Worthington-Roberts (1981) contains three factors: 1) allowance of adequate time for the athlete to achieve

optimal body weight for competition; 2) meals for weight control should be based on the nutrient needs of the athlete inclusive of protein, minerals, and vitamins so supplements are not needed; and 3) supervision of the weight control program should be monitored by someone other than the head coach, such as, the team nutritionist, trainer, physician or assistant coach.

Changes in weight should be achieved gradually, at approximately one to two pounds per week, by balancing the energy intake with the energy output (USDA-HHS, 1980). A weight gain of 0.5 to one kg/week of muscle mass is a desirable rate; a weight loss of one kg/week, not to exceed two kg/week, is recommeded for successful weight management (Worthington-Roberts, 1981). Hecker (1982) states that a weight control program should start about one or two months before the athlete's competitive season with a weight gain of 1 - 1.5 lbs/week or a weight loss of 1 - 2 lbs/week for younger boys and girls. According to Smith (1976) no weight control program should promote a weight loss exceeding four pounds a week, with two pounds a week more acceptable.

For athletes involved in weight reduction, current and desired body fat levels should be determined and used as guides in achieving weight loss. Diet modifications for weight reduction or gain should be based on the basic four food groups (Williams, 1976). Five to seven percent body fat has been recommended as a healthy level of body fat for wrestlers and athletes in other weight-conscious sports

(Smith, 1976). The American Medical Association's Committee on Medical Aspects of Sports (Hursch, 1979) established seven to ten percent body fat as the desirable level for the wrestler. A minimal caloric level for adolescent athletes in a weight control program is 2000 calories according to Smith (1976). The American Dietetic Association (1980) recommends that athletes who are no longer in training or competition reduce their caloric intake to match their reduced activity to maintain an appropriate body weight and fatness.

Food Fads

Food faddism is a widespread area of nutritional misinformation and ignorance among athletes, as well as, many others in our population (deVries, 1979; Bentivegna, Kelly, and Kalenka, 1979; Hecker, 1982). Due to a highly competitive atmosphere, a preoccupation with winning, and pressures for social and peer approval, the athlete is a prime target for nutritional misinformation (Hecker, 1982). Erogenic dietary aids popular among athletes are: wheat germ, wheat germ oil, honey, gelatin, caffeine, lecithin, yeast powder, phosphates, vitamin E, vitamin B_{15} (Gray and Titlow, 1982), ascorbic acid, sunflower seeds, bee pollen, and kelp (Williams, 1976; ADA, 1980). The athlete may derive psychological benefits from these dietary substances; yet their ergogenic effects have not been scientifically documented (National Dairy Council, 1980). Use of ergogenic

aids or dietary supplements do not improve performance, fail to correct poor nutritional habits, are often expensive, and over doses may occur with some (American Alliance for Health, Physcial Education, and Recreation, 1971).

Nutritional Knowledge Studies

Consumers

According to four United States Food and Drug Administration (FDA) surveys conducted in the 1970's, many Americans have nutritional misconceptions which pertain to weight control, "health foods", vitamins, and a balanced diet (Consumer Reports, 1977). In the 1975 FDA survey, 51 percent of the 1664 respondents were not adequately informed about food and nutrition. Approximately two out of five respondents in the FDA surveys believed that snacks were never as healthy as food eaten at regular meals; and that a variety of foods would guarantee good nutrition. Three-fourths of the consumers in the 1975 survey believed home-cooked fresh vegetables were always more nutritious than canned or frozen vegetables. Common misconceptions about weight control were held by about one-third of the respondents with the most popular myth being that carbohydrates, not excess calories, result in excess body fat. One out of four participants in the FDA surveys believed that body weight is correlated with proper nourishment.

Howat and Johnson (1980) conducted a "mini" nutritional assessment with 86 local shoppers to gain information about

their nutritional interests, knowledge, and habits. Sixty-two of the 86 participants responded. Most of the respondents were interested in their diet and realized that food and physical activity could affect their health. One-fourth of the participants indicated that the popular press and news media do not always provide the best source of nutrition information. Greater than one-half of the respondents believed that diet could cure diseases and that "health foods" would benefit their health. A majority of the participants were interested in the topic "popular diets" for weight loss.

Business Professionals

Stansfield and Fox (1977) surveyed 217 Nebraskan grocery store managers to determine their nutritional knowledge and attitudes. The results indicated that grocers most frequently missed questions regarding general food compositions, fats and polyunsaturated fats, and nutrient functions. Grocers were commonly misinformed about the caloric value of margarine versus butter and meat versus bread. Only 13 percent knew that gelatin was not a high quality protein. Grocers were very knowledgeable of the composition of milk; but unaware that cantaloupe, strawberries, and green peppers were good sources of vitamin C. The grocers did not know that some non-dairy creamers were high in saturated fat and they were not able to distinguish margarines which were high in polyunsaturated fats. Grocers

did realize that vitamin supplements were not necessary for all persons; and an excess could be harmful.

A study of 195 Canadian businessmen (Woolcott, Kawash, and Sabry, 1981) revealed that nutritional knowledge was correlated with age, higher education, and higher socio-economic status. Nutrition knowledge scores were similar for both general nutrition and nutrition and heart disease. Participation in nutrition-related activities correlated positively with nutrition knowledge ($r = 0.15$, $p.<0.02$). Subjects with higher knowledge scores tended to possess personality characteristics of being more open and imaginative.

Mothers and Children

Emmons and Hayes (1973) conducted a nutritional knowledge and practice survey with mothers and children in New York. Of the 844 children in grades one through four, 88 percent participated in the study with their mothers. The mothers identified vegetables, potatoes, and meat as the most important foods in the child's diet, but were unsure of their nutritional value. The children listed meat, dairy foods, and vegetables as the most important foods in their diets; yet, had even more difficulty than their mothers in recognizing their nutritional importance. Customs and habits were frequently the reasons for their food practices. The study indicated the mothers' nutritional practices were better than their nutritional knowledge.

Sims (1976) examined the nutritional knowledge of 163 mothers of preschool children. Each mother was also asked to identify the foods she thought important for her child to consume each day. Of the sample, 75 percent responded correctly to 65 percent of the test; and 80 percent named at least three of the basic four food groups. In this study, the variables which were positively correlated with nutritional knowledge were socioeconomic status and the "Nutrition is Important" attitude.

Phillips, Bass, and Yetley (1978) studied the effect of nutritional knowledge on the use of pre-sweetened cereal of 30 upper-middle class mothers with preschool children. This group was subdivided into families with children older than the preschool child and families with no older children. Nutrition knowledge scores for the two family groups did not vary significantly; however, the application of the mother's knowledge was different. Mothers of older children with high test scores purchased a lower percentage of pre-sweetened cereals.

Teachers

Early elementary teachers were surveyed by Petersen and Kies (1972) to determine their nutritional knowledge and attitudes. The nutritional knowledge test included the areas of general knowledge, food composition, application of food principles, and food misconceptions. The mean score was 58.3 with the highest score possible of 140. Many

teachers were uncertain of the composition of a nutritionally adequate breakfast; and 23 percent were not aware of the need to encourage variety in the diet. Approximately 80 percent of the subjects thought concentrated sweets were necessary for energy needs, and 97 percent recognized the limited nutritional value of carbonated drinks for children. Several misconceptions concerned polyunsaturated fats as evidenced by the fact that 33 percent of the respondents did not relate it to possible beneficial health effects. Elementary school teachers (17 percent) thought vitamin supplements were essential for good health care of children, while 12 percent were uncertain. Only 14 percent of the teachers considered obesity to be the result of an glandular disorder. Little relationship was shown between knowledge scores and attitudes.

Gillis and Sabry (1980) sampled 120 daycare teachers to assess their nutrition knowledge. The test consisted of indirect statements about the importance of nutrition to health and to daycare. The knowledge scores were not significantly associated with age, work experience, size of sponsorship of the center, or whether the subjects had previous nutrition training.

Shannon (1981) investigated the nutritional knowledge of 125 kindergarten through sixth grade teachers. The nutritional knowledge test included basic nutrition principles and application items. Nutritional areas evaluated were: food groups, nutrient sources, and nutrient

functions. The most difficult test items dealt with the complex nutrition concepts and resulted in 70 percent of the incorrect responses. Responses to the misconception test item about the most concentrated source of energy resulted in 21 percent of the respondents correctly selecting fat, 44 percent choosing carbohydrate, 23 percent protein, five percent vitamins, zero percent minerals, and seven percent omitted the question. From the study, results indicated that a preparatory nutrition course improved the nutritional knowledge of the teachers.

Students

Dwyer, Feldman and Mayer (1970) surveyed 1,338 high school students to evaluate their attitude and knowledge toward nutrition. Test areas which were most often answered correct were energy metabolism and output, vitamin and mineral sources, functions, and requirements. Statements dealing with fats and carbohydrates, protein, and energy intake were moderately often correct. The areas of weight control and definitions of vitamins and minerals were least often correct. In general, the girls' mean scores were higher than the boys, and college bound students had higher mean scores than those vocationally bound. The girls scored lower than the boys on the weight control and energy metabolism areas of the test; although the girls had higher overall test scores and greater personal interest in weight control.

McCarthy and Sabry (1973) studied 274 university students to determine nutritional misconceptions in seven areas of food and nutrition. The least number of misconceptions were in the groups of: 1) food purchase, storage, preparation and 2) health foods. The students incorrectly answered many items in the area of digestion, absorption, metabolism, and excretion. The area of health foods received the most "don't know" responses. Students with home economics background had fewer misconceptions in all seven food and nutrition areas than those with no home economics background. Males and females had similar misconception and correct scores.

Lindamood and Gunning (1977) studied the dietary habits and nutritional knowledge of 251 college students. Approximately 42 percent of the selected sample was vegetarians. Of the students sampled, 69 percent correctly identified the four food groups, but only nine percent knew the proper number of servings recommended for each food group. No significant difference in nutritional knowledge was found between the nonvegetarians and vegetarians.

Health Professionals

A survey of 352 public health nurses was conducted by Schwartz (1976) to determine their nutritional knowledge. Areas in which nurses received their poorest scores were nutrition and pregnancy, nutrient functions and requirements, and the nutrient value of food. Variables

significantly related to knowledge in a positive manner were use of printed material and attendance at well clinics. A negative relationship was indicated between nutritional knowledge and nurses younger than 25 years of age and those who received nutrition education from a nursing instructor.

Vickstrom and Fox (1976) administered a nutrition knowledge questionnaire to 500 hospital nurses. Out of a possible 210 points, the nurses' mean score was 112, only 50 percent accurate. While 77 percent of the test questions were answered correct, the scores were negatively affected by the nurses' uncertainty in their responses. In general, the nurses were informed in normal and therapeutic nutrition. The nurses were knowledgeable in basic nutrition principles and in the application of diet therapy. Nutritional knowledge declined with age and nursing experience.

Krause and Fox (1977) surveyed 292 physicians to determine their nutritional knowledge and attitudes. The test consisted of two main categories: normal nutrition and therapeutic nutrition. The area of normal nutrition contained topics on nutrients and their functions, food composition, general nutrition information, and nutrition related to the life cycle. Therapeutic nutrition test items were based on disease states which required diet modifications. Sixty-five percent of the total responses of the nurtition knowledge test were correct, 24 percent incorrect, and 1.1 percent were marked uncertain by the participants. Physicians tended to be more knowledgeable in basic

nutrition principles and scored higher in this area than in the therapeutic nutrition topics. A significant negative correlation ($r = 0.188$) was found between years of practice and nurtition knowledge. There was no significant relationship between attitude and nutritional knowledge.

Physical Fitness-Related Studies

A study of the nutritional knowledge of 138 collegiate physical education majors was conducted by Cho and Fryer (1974). Subjects completed a questionnaire which covered areas relating to general nutrition knowledge, food composition, and food misconceptions. About six percent of the physical education students' scores were above 200 as compared to 25 percent of the control group of students. The overall mean score for physical education students was 93.3 which was significantly lower ($p<0.01$) than that of the basic nutrition students (156.6). Eliminating the degree of certainty, responses from the physical education students averaged 40 percent correct, and from the basic nutrition students 74 percent correct. Both groups indicated a high degree of certainty in their response; yet, in truth were incorrect. Mean scores for female physical education students was 116.5, significantly higher than the physical education males mean score of 85.0. Graduate students in physical education had a mean score of 124.0, significantly higher than mean scores of the juniors (84.2) and seniors (91.1) in physical education. Basic nutrition students were

more knowledgeable about nutrition than the physical education majors (Cho and Fryer, 1974).

Many students of both groups did not recognize sources of calcium, cholesterol, and polyunsatured fats; and did not understand the functions of protein, vitamins, and fats. A common belief held by the subjects was that protein supplements would improve the athlete's performance.

Students were confused about basal metabolism, calories, and energy sources. The participants responded correctly to test items dealing with weight control, mineral functions, the effect of stress on nutrient utilization, and delayed digestion by dietary fats. Only a small percent of basic nutrition students recognized that excessive sugary foods caused digestive problems. About 50 percent of the students knew that the body can increase nutrient absorption when body stores are low. Students who ranked college courses as their major source of nutritional knowledge had significantly higher scores than students who ranked coaches or parents as their main source of nutrition information (Cho and Fryer, 1974).

Werblow, Fox and Henneman (1978) determined the nutritional knowledge, attitudes, and practices of 94 collegiate women athletes. The participants responded to a knowledge test which consisted of two categories, general nutrition and nutrition for the athlete. The subjects scored higher on test items concerned with "nutrition for athletes". Athletes were least informed about common food

misconceptions. Statements concerning organic foods, synthetic versus natural vitamins, and the dietary function of protein and carbohydrates were responded to correctly by only 30 percent of the female athletes. Nutrition knowledge and attitude were positively correlated ($r = 0.45$, $p<0.0001$).

Women athletes who had received nutrition education in high school or college had significantly higher knowledge scores and attitude scores than those who had not. Female athletes who had a high school or college nutrition course tended to follow similar dietary habits for their regular diet and their weight control diet; and, for their pre-game diet and weight control diet than those female athletes who had not had nutrition education (Werblow, Fox and Henneman, 1978).

Nutrition Education

Introduction

Nutrition education has been defined as the process by which individuals gain the understanding, skills, and motivation necessary to promote and protect their nutritional well-being through their food choices (Ullrich, 1979). The need for adequate nutrition education is universal regardless of social, cultural, economic patterns, income, location, or educational level (Todhunter, 1969). Man is not innately born with the capacity to choose food nutritionally necessary to satisfy the human body's needs. Nutritional

knowledge is not inherited and each individual must be taught the food and nutrition basics with its relationship to health.

However, the American consumer is confronted with three primary problems deterrent to acquiring optimal nutrition knowledge (Harper, 1979). These problems are: lack of information, conflicting information, and repetitive exposure to misinformation. Solutions to these problems are a major challenge for the nutrition educator to accomplish through nutrition education programs.

Formerly, nutrition education programs stressed the requisition of nutritional facts as opposed to promoting sound dietary habits which require application of the facts (Petersen and Kies, 1972). Recognition of facts alone does not guarantee improved food habits. An effective nutrition education program is built on relevant, selective nutritional information based on scientific research; satisfies the needs of the recipient; and "brings returns of discerning value" to the recipient (Briggs, 1969; Leverton, 1974).

Innovative Techniques

Nutrition educators are currently experimenting with various educational methods in an attempt to provide more meaningful nutritional learning experiences. Palgi and Sheridan (1977) presented a nutrition slide show and program text to an audience of an age range of 12 to 60 years of

age. The purpose of their research was to dispel certain food misconceptions and suggest healthier eating habits. Audience participation was dependent upon electronic feedback technology. Advantages of feedback technology were anonymity in voting and increased discussion. Evaluation of the presentation was positive. Fifty percent of the respondents stated that the electronic feedback encouraged them to participate more, 43 percent, the same as usual, and seven percent felt discouraged by the feedback. Seventy-five percent of the participants responded that the slide presentation and transparencies combined with the electronic feedback gave them a better scope of nutrition than a traditional lecture and discussion; 11 percent reported no difference; and six percent preferred a lecture and discussion.

A study by Fitzgibbons and Garcia (1977) evaluated the effect of television public service announcements on the nutrition for 65 elderly subjects. The public service annoucements (PSAs) were specifically designed as nutrition education means for elderly persons over 60 years of age. The four PSAs dealt with protein, calcium, vitamin A, and enrichment, and were shown on four networks 112 times in six weeks. Results indicated that the subjects had poor to fair recognition of the PSAs. The PSAs had no measureable effect on the elderly's nutrition knowledge scores. There was no apparent change measured on the elderly's eating habits from exposure to the PSAs.

Mass media techniques using radio, television, and a printed brochure were used by Axelson and Del Campo (1978) to impart nutritional knowledge to adolescents. The random sample consisted of 400 ninth grade students with 90 percent ranging from 14 to 15 years of age. A 10 question nutrition quiz was administered to the sample as a pre-test before the mass media campaign and as a post test afterwards. The media campaign lasted for 10 weeks. The mean net gain was .86 $\pm$ .15 SEM for the experimental group and .45 $\pm$ .17 SEM for the control. The difference was statistically significant at $p = .03$ level. Blacks had the lowest pre-test scores, but showed the greatest increase in scores. The average increase in scores were not significantly different for blacks and whites, or for boys and girls. Mass media campaigns may prove effective in nutrition education if there are special incentives and personal involvement of audience (Axelson and Del Campo, 1978).

MacKenzie and Arbor (1979) investigated the effect of cross-age teaching on the nutritional knowledge of high school students who acted as tutors. The sample consisted of 23 high school students in the experimental group with 27 secondary students matched as controls. A nutrition post test consisting of 66 multiple-choice items was used to measure a change in nutritional knowledge. The students who had tutored elementary children or the elderly had a significant difference ($p<0.01$) of 5.69 points in the mean

score of the post test over the control group who had received a traditional review of nutrition concepts.

A non-traditional teaching technique, Teams-Games-Tournaments (T-G-T), was utilized by Wodarski et al. (1980) in providing nutrition education to elementary and high school students. The T-G-T technique recognized group rather than individual success, and, allowed each student an equal chance to achieve. The T-G-T nutrition units which were presented for approximately four weeks resulted in significant increases in nutrition knowledge in all classes.

The content of the developed T-G-T nutrition unit emphasized application of nutrition concepts and behavioral skills for selecting wise food choices. Most of the students enjoyed the T-G-T nutrition unit; liked competing in a group setting; felt they had increased their nutrition knowledge; and believed that this knowledge would affect their food choices (Wodarski et al., 1980).

In 1979 and 1980, elementary students in Oklahoma were exposed to Nutrition Education and Training (NET) Team Training with the purpose of integrating nutrition education into their curriculum. The school team consisted of five to seven members, a principal, teacher, parent, and food service personnel. A study (Kopel and Ross, 1981) was conducted to determine the effect that the NET team training had on integrating nutrition education in elementary schools in Oklahoma. Results tabulated from the team members responses indicated that NET team training had had a

considerable impact on nutrition education integration into the schools; over half of the NET teams were currently active; and, each team member was considered vital for effective nutrition education.

The study further indicated that the team members felt that school lunch programs helped to form good food habits as well as provide one-third of the student's nutritional needs. After the NET team training, students became more involved in the school lunch program. The principals and teachers from the NET teams supported the need for a nutrition course as an undergraduate requirement for future teachers and administrators. Teachers revealed that they had substantially increased their nutrition knowledge and most frequently used the Oklahoma Nutrition Curriculum Guide as a teaching resource. Foodservice personnel became more aware of the importance of their attitude toward serving food. Parents reported more interest in nutrition after NET team training and a considerable change in their child's food and nutrition behavior (Kopel and Ross, 1981).

The North Dakota Nutrition Council and the State Health Department held a seminar on sports nutrition for physical education teachers and coaches (Adams, 1978). A panel discussion with a question and answer session was presented. Printed materials on nutrition related to athletes was distributed to each seminar participant. Responses evaluating the seminar were positive; and suggestions were made to conduct future workshops.

To alleviate dietary misinformation frequently presented to student-athletes, Teague and Preston (1980) developed a nutrition education componet for athletes with funding from the Nutrition Education Training program. An inservice workshop attended by coaches, school nurses, home economics teachers, and cafeteria managers was held. The workshop's program presented information about basic nutrition as well as topics directly related to athletic performance (weight control, pre- and post-game meals, electrolytes, dietary supplements, and carbohydrate loading). Results from pre- and post-tests revealed a statistically significant gain in the coaches' nutritional knowledge. Further workshops and seminars were conducted. Coaches later reported working with individual athletes on weight control, presenting nutrition seminars to their teams and/or parents, and devising alternative school lunch selections with the foodservice managers for the athletes (Teague and Preston, 1980).

Summary

Many Americans in the eighties' decade have become interested in the preventative approach to health care. Some of these individuals have selected nutrition and physical fitness activities as measures for minimizing chronic diseases and attaining a quality lifestyle. And, the continued popularity of sports and athletics have

assisted others in health maintenance as well as the traditional outlet for competition.

While food consumption patterns may have indicated better nutrition in America, some problem nutrients still exist. Calcium intake was down and dietary iron may be consumed in insufficient amounts. Caloric intake has lowered, yet body weight averages have remained stable. Fat consumption continued to remain elevated above recommended health levels. Soft drinks consumption continued its steady climb due to popular demand.

However, some consumers have become aware of dietary health risks and have made diet and/or physical activity changes in their lifes. Government and private industry have responded by advocating these health changes through publications and nutritional labeling made available to the consumer. The health benefits of physical fitness have encouraged not only the athlete but also each individual to participate regularly in a physical activitiy.

Guides for optimal nutrition for the active athlete, physical fitness participant, and the less active individual have continued to be centered on utilizing the basic four food groups and the Recommended Dietary Allowances. Special emphasis has been given to providing adequate calories and water to meet the individual's nutritional needs due to increased physical activity.

Food misinformation, fallacies, and ignorance have remained deterrents to acquisition of nutrition knowledge.

Studies to determine nutritional knowledge have been conducted with consumers; business, health, and teaching professionals; mothers and children; students; and athletes. In general, these groups have not been very knowledgeable in nutrition. Public health nurses received the highest average nutrition knowledge scores.

Innovative nutrition education has been designed which emphasizes not only the cognitive aspect of nutrition but also the application of the facts. Researchers have developed nutrition education programs which utilize games, electronic feedback, mass media, tutoring, and team teaching techniques. Several successful nutrition education programs on sports nutrition have specifically been developed for athletes, coaches, and related professionals.

CHAPTER III

METHODS AND PROCEDURES

The purpose of this chapter was to describe the research methods and procedures which were used to fulfill the objectives of the study. This chapter includes: a) Sample Selection; b) Development and Pre-testing of the Research Instrument; c) Administration of the Research Instrument; and, d) Analyses of Data.

Sample Selection

The population in this study consisted of undergraduate students enrolled at Oklahoma State University, Fall, 1983, who had not previously taken a college-level human nutrition course. The sample selected from the population were undergraduate students enrolled in a basic human nutrition course, FNIA 1113, in the Department of Food, Nutrition and Institution Administration, College of Home Economics at Oklahoma State University, Fall, 1983. Students in all three class sections comprised the total sample of 299 undergraduates. Most of the students were majoring in the College of Home Economics.

Development and Pre-testing of the Research Instrument

An objective instrument was designed by the researcher to obtain data to meet the objectives of the study. The instrument consisted of two parts: Part I was designed to obtain demographic and background information from the subjects; and, Part II was developed to obtain data on the subjects' nutritional knowledge as it relates to physical fitness.

Information from the review of the literature (AAHPER, 1971; Cho and Fryer, 1974; Smith, 1976; Werblow, Fox and Henneman, 1978; ADA, 1980; National Dairy Council, 1980) and research instruments by other researchers (McCarthy and Sabry, 1973; Schwartz, 1976; Picardi and Porter, 1976; Stansfield and Fox, 1977; Gillis and Sabry, 1980; Dwyer, Stolurow, and Orr, 1981; Bryd-Brednner, 1981; Lackey et al., 1981) were utilized in developing the specific nutritional knowledge statements as they relate to physical fitness and the instrument's format. Part II contained 42 statements with 24 false items and 18 true items. Statements were developed according to four categories of nutritional knowledge. Ten or 12 statements were developed for each category. The categories of nutritional knowledge and the specific number of statements for each were:

1. Macronutrients (Protein, Carbohydrate and Fat) - 10 statements;

2. Micronutrients (Minerals, Vitamins and Water) - 12 statements;

3. Energy and Weight Control - 10 statements; and,

4. Nutrition Principles/Meal Patterns - 10 statements.

The 42 statements were arranged in a random order for inclusion on the instrument. Randominization was done by drawing a number for each statement from a container that allowed shuffling of the numbers.

Responses for Part II of the instrument were indicated by circling either "T" for true, "F" for false, or "DK" for don't know. The don't know response allowed the subjects to indicate no knowledge of the statement, or uncertainty about the correctness of the answer which eliminated guessing and forced responses.

Three nutrition knowledge scores were determined for each subject (Dugdale, Chandler, and Baghurst, 1979; Poplin, 1980). These scores were determined according to:

1. Perceived Knowledge Score = Number of statements circled true or false divided by the total number of statements (42). Example: $30 \div 42 = .71 = 71$ percent.

2. Accurate Knowledge Score = Number of correct responses divided by the number of statements circled true or false. Example: $25 \div 30 = .83 =$ 83 percent.

3. Correct Knowledge Score = Number of correct

responses divided by the total number of statements (42). Example: 25 ÷ 42 = .59 = 59 percent.

Content validity was established by an analysis of the instrument by seven faculty members in the Department of Food, Nutrition and Institution Administration and three faculty members of the School of Health, Physical Education, and Leisure Science. Following their review, the instrument was revised by rewording, eliminating, and adding statements according to their suggestions and recommendations.

After the revision of the research instrument, the survey was pre-tested for reliability with five undergraduate students enrolled at Oklahoma State University, Summer, 1983. These students had not had a previous college-level course in human nutrition. Suggestions for clarity of specific statements were obtained from the students. Revisions were made as recommended. A copy of the research instrument and the answer key are found in the appendixes.

Administration of the Research Instrument

The researcher requested permission from the head of the Department of Food, Nutrition and Institution Administration and the instructors of the basic human nutrition course (FNIA 1113) at Oklahoma State University to administer the research instrument. Permission was granted to administer the survey to the three class sections of the

basic human nutrition course. There were 99, 100, and 99 students enrolled in each section, respectively. Oral and written instructions were given by the researcher. Questions asked by the students were clarified by the researcher. The students completed the survey during the last 20 minutes of the first class period, Fall semester, 1983. The surveys were returned to the researcher as they were completed.

Analyses of the Data

Before the statistical analysis, the collected data was coded, transposed, and keypunched for computer processing at the Oklahoma State University Computer Center using SAS (Helwig and Council, 1979). Responses from the research instrument were compiled to obtain frequencies and percentages for each item of the instrument. An analysis of variance (ANOVA) determined if a significant difference existed in the mean nutrition knowledge scores associated with the selected variables a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background. Duncan's multiple range test determined the location of significant difference at the $p < 0.05$ confidence level (Snedecor and Cochran, 1980).

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to determine the nutritional knowledge as it relates to physical fitness of undergraduate students enrolled in a basic human nutrition course at Oklahoma State University. Chapter IV presents the data of demographic and background information of the subjects, scores of nutritional knowledge, and results of testing of the hypotheses.

Demographic and Background Information of the Subjects

The subjects in this study included 299 undergraduate students enrolled in a basic human nutrition course, FNIA 1113, Fall semester 1983 at Oklahoma State University. Only those students who had not previously completed a college human nutrition course were included in the study. Forty-three students were eliminated due to one of the following reasons: a) absence from the initial class meetings when the research instrument was administered; b) prior completion of a college human nutrition course; c) partial completion of the research instrument; and, d) classification as a special or graduate student. The final sample

totaled 256 undergraduates with 189 females and 67 males (Table I). The ages of the subjects ranged from less than 18 years to over 21 years of age. Approximately half (55%) of the undergraduates were less than 20 years, while the other half (45%) was over 20 years of age. About one-fifth (17.9%) of these students were above 21 years of age (Table I). Of the sample, approximately 70 percent were classified as sophomores (40.2%) and juniors (29.7%) (Table I).

Most of the undergraduates (93%) were enrolled in the College of Home Economics (66.0%) followed by the College of Arts and Sciences (27.0%) (Table II). The basic human nutrition course, FNIA 1113, is a required course for undergraduates enrolled in the College of Home Economics, and an elective for students enrolled in other colleges on campus. The subjects (N=171) indicated majors in the College of Home Economics while 85 students had either selected majors in other colleges (N=72) or were undecided (N=13) (Table II). Those enrolled in colleges other than Home Economics indicated majors in health professions (N=44), business (N=12), social sciences (N=7), education (N=6), and science (N=3).

Background information concerning nutrition and physical fitness was asked of the sample to meet the objectives of the study. Fifty-seven percent (N=146) of the undergraduates participated regularly in a physical fitness activity, exercise, or sport (Table III). Regular was defined as three or more times a week for a continuous time

TABLE I

NUMBER AND PERCENTAGE OF RESPONSES ACCORDING TO SEX, AGE IN YEARS AND CLASS LEVEL
N=256

Sex	Number	Percentage
Female	189	73.8
Male	67	26.2
Total	256	100.0

Age	Number	Percentage
Under 18	3	1.2
18 - 19	71	27.7
19 - 20	68	26.6
20 - 21	68	26.6
Over 21	46	17.9
Total	256	100.0

Class Level	Number	Percentage
Freshmen	44	17.2
Sophomore	103	40.2
Junior	76	29.7
Senior	33	12.9
Total	256	100.0

TABLE II

NUMBER AND PERCENTAGE OF RESPONSES IN DESCENDING ORDER ACCORDING TO COLLEGE OF ENROLLMENT AND MAJOR
N=256

College	Number	Percentage
Home Economics	169	66.0
Arts and Sciences	69	27.0
Business Administration	9	3.5
Education	6	2.3
Agriculture	2	0.8
Engineering, Technology, and Architecture	1	0.4
Veterinary Medicine	0	0.0
Total	256	100.0

Major	Number	Percentage
Hotel and Restaurant Administration	61	23.8
Clothing, Textiles, and Merchandising	39	15.2
Family Relations and Child Development	31	12.1
Food, Nutrition, and Institution Administration	15	5.9
Housing, Design, and Consumer Resource	13	5.1
Home Economics Education and Community Services	12	4.7
Other	72	28.1
Undecided	13	5.1
Total	256	100.0

interval of 20 or more minutes. Almost all of the subjects in the sample (99.6%) felt that nutrition was very important or important to physical fitness (Table III). Of the sample, 70.3 percent of the subjects revealed they had some, little or no knowledge about the role of nutrition as it relates to physical fitness (Table III).

Over one half of the sample (51.2%) had never studied nutrition, while 35.9 percent had studied nutrition in junior or senior high school or as part of another college course (Table IV). The remainder of the subjects (N=33) obtained nutritional background on their own (N=13), from other classes or courses (N=12), and from human resources e.g., parents, physicians, dietitians (N=8). Of the sample, 76.6 percent (N=196) had not studied nutrition as it relates to physical fitness (Table IV).

Of the 256 subjects, 60 indicated having had a past nutritional background source which included a component on nutrition's role in physical fitness. Only 51 subjects of the 60, however, responded about the amount of time allotted in the past nutritional background source for nutrition as it relates to physical fitness. Four or more hours (27.5%) was the category of time most frequently chosen by the subjects (N=51). Frequencies and percentages can be seen in Table V. The six subjects who responded "other" had either read a chapter(s) in a book or could not remember an exact amount of time.

TABLE III

NUMBER AND PERCENTAGE OF RESPONSES ACCORDING TO FITNESS PARTICIPATION, FELT DEGREE OF IMPORTANCE OF NUTRITION TO FITNESS, AND PERCEIVED KNOWLEDGE
N=256

Participation		Number	Percentage
Yes		146	57.0
No		109	42.6
No Repsonse		1	0.4
	Total	256	100.0

Degree of Importance		Number	Percentage
Very Important		166	64.8
Important		89	34.8
Little Importance		0	0.0
None		0	0.0
No Opinion		1	0.4
	Total	256	100.0

Perceived Knowledge		Number	Percentage
A Great Deal		21	8.2
Quite A Bit		54	21.1
Some		138	53.9
Very Little/None		42	16.4
No Response		1	0.4
	Total	256	100.0

TABLE IV

NUMBER AND PERCENTAGE OF RESPONSES ACCORDING TO PAST NUTRITIONAL BACKGROUND AND THE INCLUSION OF A PHYSICAL FITNESS COMPONENT
N=256

Background	Number	Percentage
Studied in junior or senior high school	71	27.7
Studied as part of college course	21	8.2
Have never studied nutrition	131	51.2
Other	33	12.9
Total	256	100.0

Physical Fitness Component	Number	Percentage
Yes	60	23.4
No	196	76.6
Total	256	100.0

The undergraduates in this study were asked to identify all sources of nutrition information, both people and technological resources. The responses indicated that parents (67.6%) and physicians/nurses (43.8%) were prime people resources for nutrition information. Friends/ classmates (39.1%) and athletic coaches/trainers (37.5%) received a higher percentage of the responses over both home economics teachers (34.4%) and dietitians/nutritionists (10.9%). Teachers, science instructors, and siblings were

other sources of nutrition information (Table VI). These results indicate that dietitians/nutritionists were not considered sources of nutrition information by the undergraduate students, and this requires further investigation.

TABLE V

NUMBER AND PERCENTAGE OF RESPONSES ACCORDING TO TIME ALLOTED IN THE PAST NUTRITIONAL BACKGROUND SOURCE FOR NUTRITION AS IT RELATES TO PHYSICAL FITNESS

Time	Number (N=256)	Percentage
Less than 60 minutes	11	4.3
1 hour - 2 hours	10	3.9
2 hours - 3 hours	3	1.2
3 hours - 4 hours	7	2.7
More than 4 hours	14	5.5
Other	6	2.3
None	205	80.1
Total	256	100.0

Time	Number (N=51)	Percentage
Less than 60 minutes	11	21.5
1 hour - 2 hours	10	19.6
2 hours - 3 hours	3	5.9
3 hours - 4 hours	7	13.7
More than 4 hours	14	27.5
Other	6	11.8
Total	51	100.0

TABLE VI

NUMBER AND PERCENTAGE OF RESPONSES IN DESCENDING ORDER ACCORDING TO NUTRITION INFORMATION RESOURCES
N=256

People Resource	Number	Percentage[1]
Parents	173	67.6
Physicians/Nurses	112	43.8
Friends/Classmates	100	39.1
Athletic Coaches/Trainers	96	37.5
Home Economics Teachers	88	34.4
Dentists	44	17.2
Other	29	11.3
Dietitians/Nutritionists	28	10.9
Druggists/Pharmacists	20	7.8
Sales Person in Health Food Store	16	6.3
Home Extension Agents	6	2.3
Technological Resource	**Number**	**Percentage[1]**
Television	167	65.2
Popular Magazines	143	55.9
Food Product Labels	119	46.5
Textbooks	105	41.0
Cookbooks	93	36.3
Popular Diet Paperbacks	66	25.8
Radio	60	23.4
Popular Books	54	21.1
Government Publications	33	12.9
Professional Journals	21	8.2
Other	7	2.7

[1]Subjects indicated all possible resources, therefore totals will not equal 100 percent.

Responses from the sample identified television (65.2%) and popular magazines (55.9%) as their main technological resources for obtaining nutrition information. Food product labels (46.6%) and textbooks (41.0%) received the next highest proportion of the undergraduates' responses (Table VI).

A large percentage (85.2%) of the undergraduates indicated an interest in learning more about nutrition as it relates to physical fitness (Table VII). The subjects were asked to indicate all topics of interest. Specific topics of interest which were identified by the respondents were weight gain/loss (91.4%), vitamin/mineral supplements (62.5%), fluid requirements (50.8%), and caloric requirements (46.1%). A relatively small proportion of the subjects were interested in pre-event meals (25.8%) or carbohydrate-loading (17.2%) (Table VII).

Evaluation of Nutritional Knowledge

Part II of the survey (Appendix A) obtained data of nutritional knowledge as it relates to physical fitness. The 42 statements represented four categories of nutrition: 1) macronutrients, 2) micronutrients, 3) energy and weight control, and 4) nutrition principles and meal patterns (Table VIII).

The range of correct responses marked "true" or "false" by the subjects was two to 34 (Figure 1). Seventeen statements was the most frequent number of statements

TABLE VII

NUMBER AND PERCENTAGE OF RESPONSES IN DESCENDING ORDER ACCORDING TO INTEREST IN LEARNING MORE ABOUT NUTRITION AS IT RELATES TO PHYSICAL FITNESS AND TOPIC OF NUTRITIONAL INTEREST
N=256

Interest	Number	Percentage
Yes	218	85.2
No Opinion	32	12.5
No	5	2.0
No Response	1	0.3
Total	256	100.0

Topic	Number	Percentage[1]
Weight Gain/Loss	234	91.4
Vitamin/Mineral Supplements	160	62.5
Fluid Requirements	130	50.8
Caloric Requirements	118	46.1
Protein Needs	90	35.2
Dietary Needs	88	34.4
Carbohydrates in the Athlete's Diet	71	27.7
Fat in the Athlete's Diet	70	27.3
Pre-event Meals	66	25.8
Non-traditional Food Intake	65	25.4
Carbohydrate-Loading	44	17.2
Sports Anemia	33	12.9
The Diabetic Athlete	28	10.9
Other	6	2.3

[1]Subjects indicated all possible topics; therefore totals will not equal 100 percent.

TABLE VIII

STATEMENTS ANSWERED CORRECTLY BY NUMBER AND PERCENTAGE IN DESCENDING ORDER (N=256)

Statement Number	Concept of Statement	Correct		Don't Know	
		N	%	N	%
4.	Diet and exercise	239	93.4	9	3.5
3.	Alcohol as quick energy	233	91.0	21	8.2
25.	Basic four food groups	219	85.5	33	12.9
14.	Balancing body weight	214	83.6	36	14.1
26.	Fat-restricted diet	188	73.4	56	21.9
5.	Need for dietary iron	185	72.3	63	24.6
40.	Calorie restriction	182	71.1	60	23.4
21.	Fat in the pre-game meal	175	68.4	70	27.3
22.	Low calorie diet	163	63.7	77	30.1
28.	No water at meals	156	60.9	74	28.9
16.	Vitamin dosage	151	58.9	82	32.0
6.	Pre-game meal timing	146	57.0	82	32.0
31.	Body fat weight loss	131	51.2	105	41.0
18.	Energy nutrients	129	50.4	102	39.8
32.	No water at practice	125	48.8	78	30.5
34.	Elimination of bread and potatoes	114	44.5	112	43.8
17.	Composition of pre-game meal	107	41.8	133	51.9
1.	Ice to quench thirst	104	40.6	83	32.4
27.	Steak for pre-game meal	101	39.5	131	51.2
13.	Salt tablet supplementation	99	38.7	95	37.1
39.	Weekly weight loss - 5 pounds	94	36.7	116	45.3
2.	Calorie for 1 pound weight loss	92	35.9	117	45.7
30.	Complex carbohydrates	90	35.2	97	37.9
38.	Dietary beverage supplements	89	34.8	79	30.9
35.	Excessive sugar - dehydration	79	30.9	164	64.1
42.	Milk intake restriction	79	30.9	149	58.2
8.	Basic nutritional needs	69	26.9	72	28.1
7.	Protein storage	68	26.6	98	38.3
36.	Sweet "quick energy" foods	66	25.8	94	36.7
10.	Thirst as indicator for water need	64	25.0	55	21.5
15.	Protein as energy source	64	25.0	93	36.3
19.	Fat-soluble vitamins	54	21.1	181	70.7
41.	Carbohydrate-loading	48	18.8	199	77.7

TABLE VIII (Continued)

Statement Number	Concept of Statement	Correct N	Correct %	Don't Know N	Don't Know %
29.	Vitamin supplements	47	18.4	114	44.5
20.	Carbohydrate-loading	44	17.2	157	61.3
23.	Gelatin as quality protein	44	17.2	158	61.7
12.	Protein supplements	36	14.1	119	46.5
24.	Honey for quick energy	35	13.7	121	47.3
37.	Diet modification for athletes	30	11.7	108	42.2
11.	Wheat germ - vitamin E	22	8.6	206	80.5
9.	High protein diet	21	8.2	109	42.6
33.	Vitamin B-15	11	4.3	217	84.8

answered correctly. No subject answered correctly more than 34 of the 42 statements. The number of statements attempted marked as "true" or "false" regardless of their correctness ranged from two to 41 (Figure 2). No subject attempted to answer all of the 42 statements with a "true" or a "false" response.

Three different nutrition knowledge scores were obtained for each subject from the responses. These nutrition knowledge scores were a "perceived" score, an "accurate" score, and a "correct" score. "Perceived" referred to the nutrition knowledge which the subjects believed they knew. (Number of statements circled true or false divided by the total number of statements, 42). "Accurate" nutrition knowledge referred to the actual

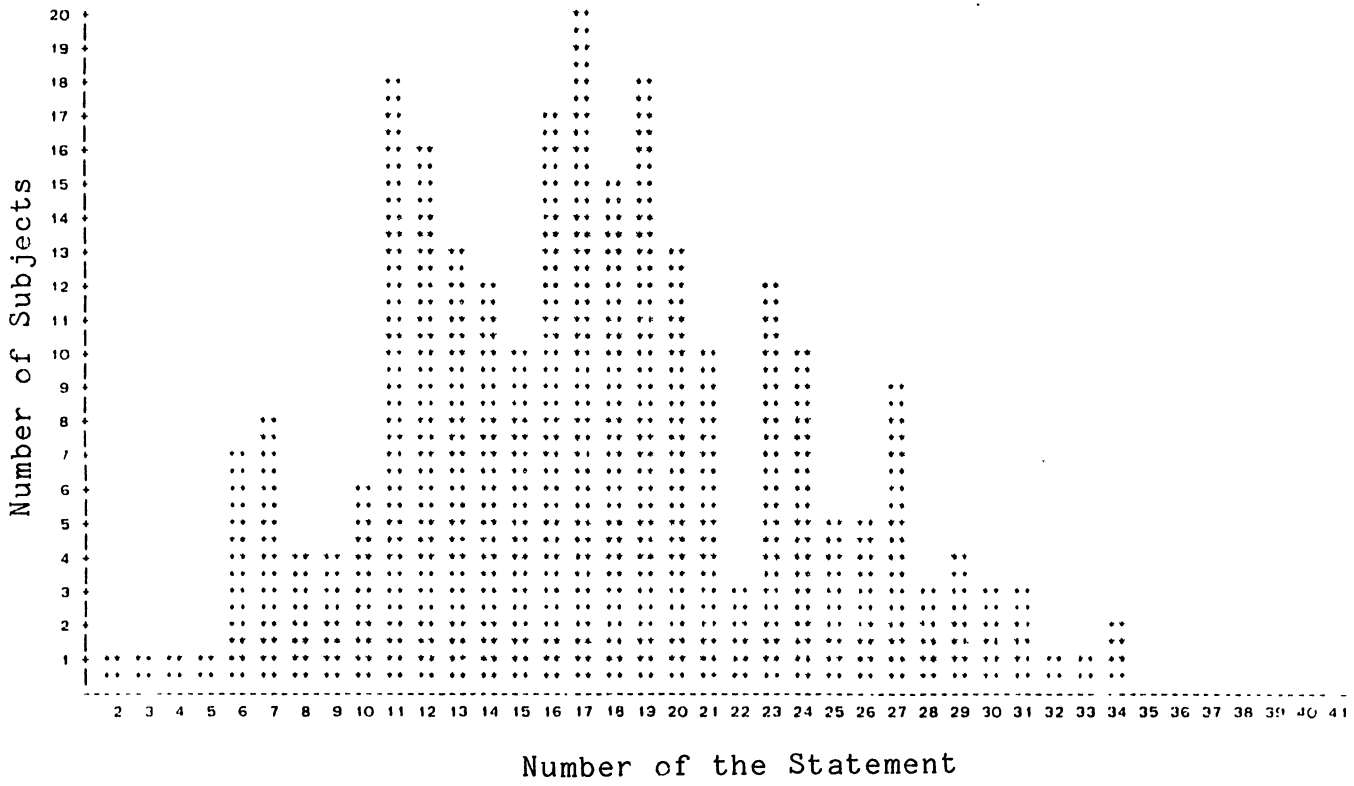

Figure 1. Range of Statements Answered Correctly

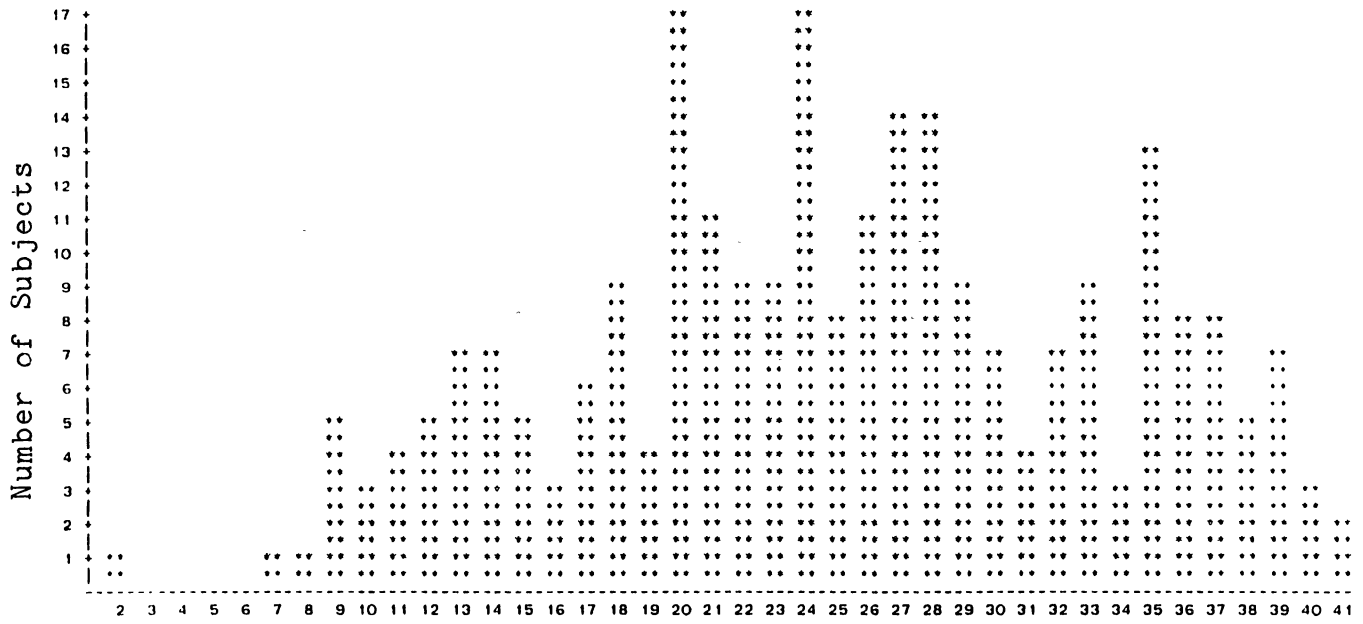

Figure 2. Range of Attempted Statements

correctness of what the subjects believed they knew. (Number of correct responses divided by the number of statements circled true or false.) And, "correct" nutrition knowledge pertained to how right the subjects were concerning the total nutrition knowledge presented, regardless of what they "perceived" they knew. (Number of correct responses divided by the total number of statements, 42.)

The "perceived" nutrition knowledge scores for the undergraduates ranged from 4.8 percent to 97.6 percent, with a mean score of 59.6 percent. The "accurate" nutrition knowledge scores ranged from 33.3 percent to 100 percent, with a mean score of 68.9 percent. The range of scores for "correct" nutrition knowledge was 4.8 percent to 81.0 percent, with a mean score of 41.0 percent (Figure 3). Table IX presents the range and mean score of the nutrition knowledge.

TABLE IX

RANGE AND MEAN SCORE OF NUTRITION KNOWLEDGE
N=256

Nutrition Knowledge Score	Range (%)	Mean Score (%)
Perceived	4.8 to 97.6	59.6
Accurate	33.3 to 100.0	68.9
Correct	4.8 to 81.0	41.0

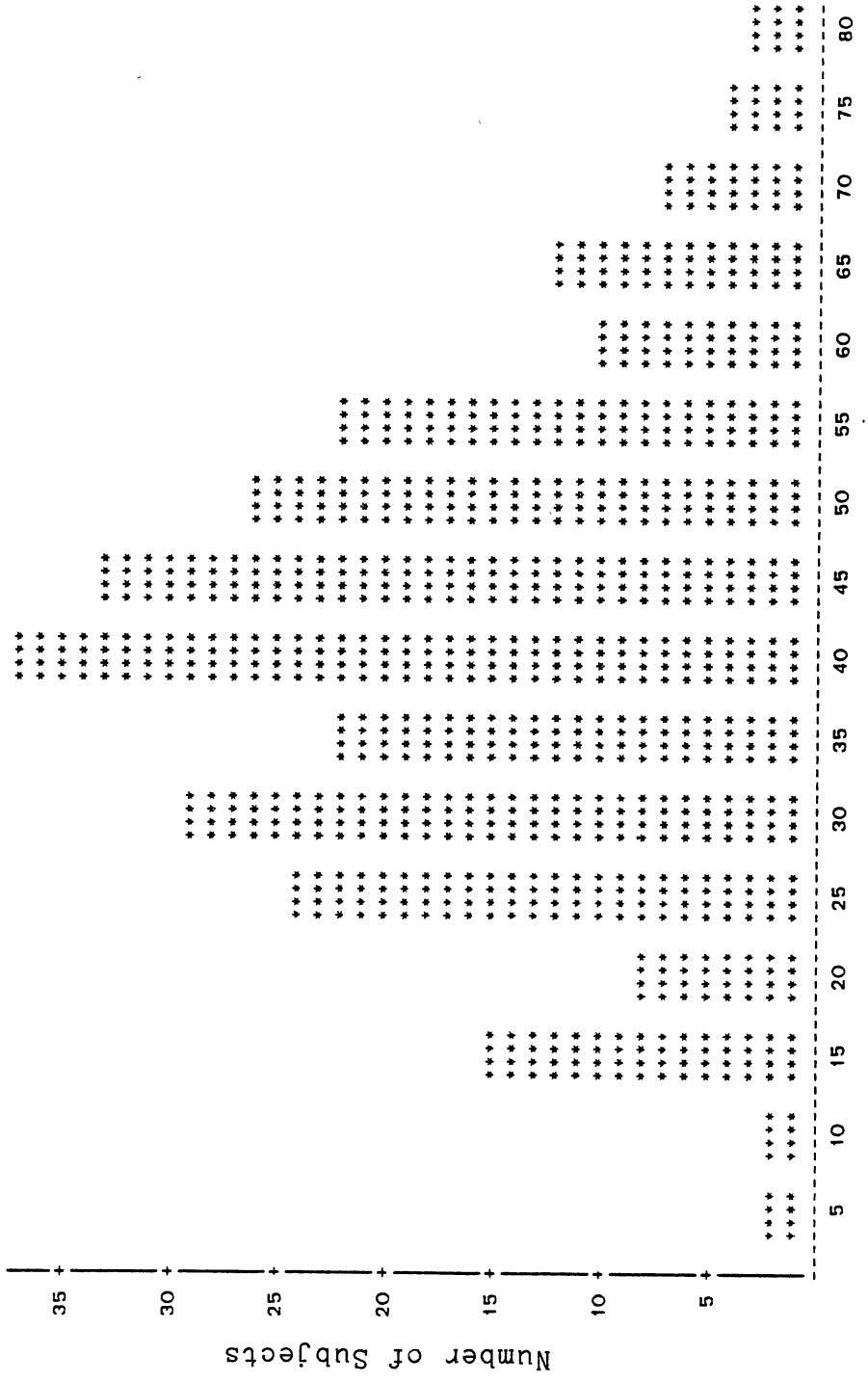

Figure 3. Range of the "Correct" Knowledge Scores

The researcher acknowledges that the "accurate" nutrition knowledge scores may be misleading due to the fact that the subjects could respond "true" or "false" to a minimal number of statements correctly which results in an exceptionally high score. For example, a subject could answer correctly "true" or "false" to 10 out of 11 attempted statements from the total of 42 statements. A high "accurate" nutrition knowledge score (10 correct statements divided by 11 attempted statements) or 91 percent would result. A "perceived" nutrition knowledge score (11 attempted statements divided by the total number of statements, 42) of 26.2 percent and a "correct" nutrition knowledge score (10 correct statements divided by 42 total statements) of 23.8 percent would also be determined.

Further data determined a mean "perceived", "accurate", and "correct" nutrition knowledge score for each of the 42 statements (Table X). The researcher arbitrarily selected the mean score of 50 percent to determine whether the subjects had knowledge concerning the statement. Statements with mean scores less than 50.0 percent indicated lack of knowledge, while mean scores greater than 50.0 percent revealed knowledge about that statement by the subjects. The subjects "perceived" they knew 32 of the 42 nutrition knowledge statements by scoring greater than 50 percent on each of those statements (Table X). The top 5 of the 32 statements which the subjects believed they knew included combining diet and exercise for good health, alcohol as an

TABLE X

STATEMENTS ANSWERED BY NUMBER AND MEAN SCORE ACCORDING TO "PERCEIVED", "ACCURATE", AND "CORRECT" NUTRITION KNOWLEDGE (N=256)

Statement Number	Concept of Statement	Perceived[1] N	Perceived[1] %	Accurate[2] N	Accurate[2] %	Correct[3] N	Correct[3] %
1.	Ice to quench thirst	173	67.6	104	60.1	104	40.6
2.	Calories for 1 lb. weight loss	139	54.3	92	66.2	92	35.9
3.	Alcohol as quick energy	235	91.8	233	99.1	233	91.0
4.	Diet and exercise	246	96.1	239	97.2	239	93.4
5.	Need for dietary iron	193	75.4	185	95.9	185	72.3
6.	Pre-game meal timing	174	68.0	146	83.9	146	57.0
7.	Protein storage	158	61.7	68	43.0	68	26.6
8.	Basic nutritional needs	184	71.9	69	37.5	69	27.0
9.	High protein diet	147	57.4	21	14.3	21	8.2
10.	Thirst as indicator for water need	201	78.5	64	31.8	64	25.0
11.	Wheat germ - vitamin E	50	19.5	22	44.0	22	8.6
12.	Protein supplements	137	53.5	36	26.3	36	14.1
13.	Salt tablet supplementation	160	62.5	99	61.9	99	38.7
14.	Balancing body weight	220	85.9	214	97.3	214	83.6
15.	Protein as energy source	163	63.7	64	39.3	64	25.0
16.	Vitamin dosage	174	68.0	151	86.7	151	59.0
17.	Composition of pre-game meal	122	47.7	107	87.7	107	41.8
18.	Energy nutrients	154	60.2	129	83.8	129	50.4
19.	Fat-soluble vitamins	75	29.3	54	72.0	54	21.1
20.	Carbohydrate-loading	98	38.3	44	44.9	44	17.2
21.	Fat in the pre-game meal	186	72.7	175	94.1	175	68.4
22.	Low calorie diet	177	69.1	163	92.1	163	63.7
23.	Gelatin as quality protein	98	38.3	44	44.9	44	17.2
24.	Honey for quick energy	135	52.7	35	25.9	35	13.7
25.	Basic four food groups	223	87.1	219	98.2	219	85.5
26.	Fat-restricted diet	200	78.1	188	94.0	188	73.4
27.	Steak for pre-game meal	125	48.8	101	80.1	101	39.5
28.	No water at meals	182	71.1	156	85.7	156	61.0
29.	Vitamin supplements	140	54.7	47	33.6	47	18.4
30.	Complex Carbohydrates	159	62.1	90	56.6	90	35.2
31.	Body fat weight loss	151	59.0	131	86.8	131	51.2
32.	No water at practice	178	69.5	125	70.2	125	48.8
33.	Vitamin B_{15}	39	15.2	11	28.2	11	4.3
34.	Elimination of bread & potatoes	144	56.3	114	79.2	114	44.5
35.	Excess sugar - dehydration	92	36.0	79	85.9	79	30.1
36.	Sweet "quick energy" foods	162	63.3	66	40.7	66	25.8
37.	Diet modificationfor athletes	145	56.6	30	20.7	30	11.7
38.	Dietary beverage supplements	174	68.0	89	51.1	89	34.8
39.	Weekly weight loss - 5 pounds	138	53.9	94	68.1	94	36.7
40.	Caloric restriction	196	76.6	182	92.9	182	71.1
41.	Carbohydrate-loading	57	22.3	48	84.2	48	18.8
42.	Milk intake restriction	106	41.4	79	74.5	79	30.9

[1]Perceived = Number of statements circled true or false ÷ total number of statements (42). Example: 30 ÷ 42 = 71%.

[2]Accurate = Number of correct responses ÷ number of statements circled true or false. Ex: 25 ÷ 30 = 83%.

[3]Correct = Number of correct responses ÷ total number of statements (42). Example: 25 ÷ 42 = 59%.

energy source, balancing body weight through energy input and output, the basic four food groups, and thirst as an indicator of fluid needs. Statements with scores less than 50 percent dealt with vitamins (fat-soluble, vitamin E, and vitamin B_{15}), the pre-game meal (steak), carbohydrate-loading, gelatin as high quality protein, excess sugar (dehydration), and milk intake restriction (Table X).

The undergraduates were "accurate" on 28 statements out of the 42 by scoring greater than 50 percent on them. The top 5 statements out of 28 which the students were accurate about pertained to alcohol as an energy source, the basic four food groups, diet and exercise for good health, balancing body weight, and the need for dietary iron. Statements with scores less than 50 percent included protein (storage, supplementation, energy source), high protein diets, basic nutritional needs of athletes, vitamins (B_{15} and supplementation), carbohydrate-loading, "quick" energy foods, thirst as indicator of need for water, gelatin, honey, and wheat germ (Table X).

Of the 42 statements, the subjects were "correct" on only 14 statements which received scores greater than 50 percent. The top 5 statements out of 14 which many subjects answered correctly dealt with diet and exercise, alcohol as an energy source, basic four food groups, balancing body weight, and the fat-restricted diet. In general, the subjects did not answer correctly the statements dealing with protein, vitamins, carbohydrates; fluids,

carbohydrate-loading, the pre-game meal, basic nutritional needs of athletes, dietary supplements, gelatin and honey, weight loss, and milk intake restriction (Table X).

Of the 42 statements, there were four statements common to each of the three different nutrition knowledges which the subjects not only believed they knew, but also were accurate and correct. These four statements pertained to 1) combining diet and exercise for good health, 2) alcohol as a source of energy, 3) balancing body weight through input and output, and 4) the basic four food groups (Table X).

Testing of the Hypotheses

An analysis of variance (ANOVA) statistical technique was used to determine if there was a significant difference in the mean nutrition knowledge scores of the sample associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background. Duncan's multiple range test determined the location of significant differences at the $p<0.05$ confidence level.

Hypothesis One

H_1: There will be no significant difference in the mean "perceived" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

Mean scores and Duncan's multiple range test results for "perceived" nutrition knowledge of the subjects according to the selected variables are presented in Table XI. Results of analysis of variance statistical technique are shown in Table XII.

The mean "perceived" nutrition knowledge score was 59.6 percent for the undergraduates (Table IX). The male subjects (N=67) had a significantly higher mean score (67.8%) for "perceived" knowledge than did the 189 females with a mean score of 56.7 percent (Table XI).

The subjects (N=146) who participated in a physical fitness activity had a mean "perceived" score of 63.5 percent which was significantly different from the mean score (54.3%) of those who did not participate (N=109) (Table XI).

Of the undergraduate students, 138 believed they had some knowledge of nutrition's role in physical fitness. Their mean "perceived" score was 57.2 percent. Fifty-four subjects perceived they knew quite a bit about nutrition as it relates to physical fitness and their mean score was 71.8 percent. A mean score of 64.9 percent was determined for 21 subjects who felt they knew a great deal. There were 42 undergraduates who believed they knew very little to none and had a mean "perceived" score of 49.3 percent. A significant difference existed between the mean "perceived" scores of the subjects who felt they knew quite a bit and those who believed they knew some or very little/none.

TABLE XI

MEAN SCORES FOR "PERCEIVED" NUTRITION KNOWLEDGE ACCORDING TO SEX, FITNESS PARTICIPATION, PERCEIVED KNOWLEDGE, AND NUTRITIONAL BACKGROUND

Sex		Number	Mean Scores (%)[1]
Male		67	67.8 A[1]
Female		189	56.7 B[1]
	Total	256	
Fitness Participation		**Number[2]**	**Mean Scores (%)[1]**
Yes		146	63.5 A[1]
No		109	54.3 B[1]
	Total	255	
Perceived Knowledge		**Number[2]**	**Mean Scores (%)[1]**
Quite a bit		54	71.8 A[1]
A great deal		21	64.9 A B[1]
Some		138	57.2 C B[1]
Very little/none		42	49.3 C[1]
	Total	255	
Nutrition Background		**Number**	**Mean Scores (%)[1]**
Other		33	69.8 A[1]
Have studied nutrition as part of a college course		21	64.4 A B[1]
Studied nutrition in junior or senior high school		71	60.7 B[1]
Have never studied nutrition		131	55.7 B[1]
	Total	256	

[1]Mean scores with unlike letters are significantly different ($p<0.05$).

[2]One subject failed to respond to the item.

There was also a significant difference between subjects who believed they knew a great deal and those who felt they knew very little/none (Table XI).

TABLE XII

RESULTS OF ANALYSIS OF VARIANCE FOR "PERCEIVED" NUTRITION KNOWLEDGE SCORES

Source	DF	ANOVA SS	F Value	Observed Significance Level
Sex	1	6135.74	16.57	0.0001
Physical Fitness Participation	1	5225.88	13.98	0.0002
Perceived Knowledge	3	13855.48	13.43	0.0001
Nutritional Background	3	5943.38	5.30	0.0016

There were 131 undergraduates in the sample with a mean "perceived" score of 55.7 percent who had never studied nutrition. Seventy-one subjects with a mean score of 60.7 percent had studied nutrition in junior or senior high school, while 21 students who studied nutrition as part of a college course had 64.4 percent as their mean score. Thirty-three subjects had the highest mean "perceived" score

of 69.8 percent and received their background in nutrition from other sources e.g., on their own, other classes, from people. A statistically significant difference was shown between the mean "perceived" scores of subjects who obtained their nutritional background from other sources and those who studied nutrition in junior or senior high school, or had never studied nutrition (Table XI).

There was a significant difference in the mean "perceived" nutrition knowledge sores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background at the $p<0.05$ level; therefore H_1 is rejected by the researcher.

Hypothesis Two

H_2: There will be no significant difference in the mean "accurate" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

The subjects' "accurate" scores and results of the Duncan's multiple range test are shown in Table XIII. An analysis of variance for the "accurate" nutrition knowledge scores is presented in Table XIV.

The overall mean "accurate" nutrition knowledge score for the sample was 68.9 percent (Table IX). The mean "accurate" score (70.1%) of the female undergraduates (N=189) was significantly different from the males' (N=67)

TABLE XIII

MEAN SCORES FOR "ACCURATE" NUTRITION KNOWLEDGE ACCORDING TO SEX, FITNESS PARTICIPATION, PERCEIVED KNOWLEDGE, AND NUTRITIONAL BACKGROUND

Sex		Number	Mean Scores (%)[1]
Female		189	70.1 A[1]
Male		67	65.6 B[1]
	Total	256	

Fitness Participation		Number[2]	Mean Scores (%)[1]
Yes		146	69.0 A[1]
No		109	68.9 A[1]
	Total	255	

Perceived Knowledge		Number[2]	Mean Scores (%)[1]
A great deal		21	73.7 A[1]
Some		138	69.9 A[1]
Quite a lot		54	68.9 A[1]
Very little/none		42	63.2 B[1]
	Total	255	

Nutritional Background		Number	Mean Scores (%)[1]
Other		33	71.8 A[1]
Have studied nutrition as part of a college course		21	69.7 A[1]
Have never studied nutrition		131	68.9 A[1]
Studied nutrition in junior or senior high school		71	67.4 A[1]
	Total	256	

[1]Mean scores with unlike letters are significantly different ($p<0.05$).

[2]One subject failed to respond to the item.

mean score, 65.6 percent. The 146 subjects who were involved in physical fitness activities failed to show a significant difference in their mean "accurate" score of 69.0 percent and the mean score (68.9%) of the non-participators (N=109) (Table XIII).

TABLE XIV

RESULTS OF ANALYSIS OF VARIANCE FOR "ACCURATE" NUTRITION KNOWLEDGE SCORES

Source	DF	ANOVA SS	F Value	Observed Significance Level
Sex	1	968.84	6.37	0.0122
Physical Fitness Participation	1	0.05	0.00	0.9855
Perceived Knowledge	3	1974.92	4.39	0.0051
Nutritional Background	3	452.26	0.97	0.4088

The mean "accurate" score (63.2%) of the students (N=42) who believed they had very little to no nutrition knowledge was significantly different from the mean scores of the subjects who perceived they knew quite alot (N=54, 68.9%), some (N=138, 69.9%), and a great deal (N=21, 73.7%).

There was no significant difference in mean scores of subjects who felt they knew quite a lot, some, or a great deal (Table XIII).

No significant difference was determined in the mean "accurate" scores of the subjects whose nutritional background was from other sources (N=33, 71.8%), part of a college course (N=21, 69.7%), never studied nutrition (N=131, 68.9%), and junior or senior high school (N=71, 67.4%) (Table XIII).

There was a significant difference in the mean "accurate" nutrition knowledge scores associated with the variables of a) sex and c) perceived knowledge; but no significant difference was associated with b) physical fitness participation and d) nutritional background at the $p<0.05$ level. The researcher rejects H_2 for the variables of a) sex and c) perceived knowledge, yet, does not reject H_2 for the variables of b) physical fitness participation, and d) nutritional background.

Hypothesis Three

H_3: There will be no significant difference in the mean "correct" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

The mean scores for "correct" nutrition knowledge and the Duncan's multiple range test results are presented in

Table XV. The results of the analysis of variance and Duncan's multiple range test are shown in Table XVI.

The mean score for "correct" nutrition knowledge of the undergraduate students was 41.0 percent (Table IX). Male undergraduates (N=67) had a significantly different "correct" mean score (44.8%) from the 189 female undergraduates' mean score of 39.6 percent (Table XV).

Of the sample, students (N=54) who perceived they knew quite a bit did not differ significantly in their "correct" score of 49.7 percent when compared to the mean score (48.4%) of subjects (N=21) who felt they knew a great deal about nutrition as it relates to physical fitness. Subjects who felt they knew quite a bit (N=54) and a great deal (N=21) had mean "correct" scores (49.7%, 48.4%) which were statistically different from mean scores of students who knew some (N=138, 39.8%) or very little/none (N=42, 30.1%) (Table XV).

Undergraduates (N=33) who had received their nutritional background from other sources did not significantly differ in their mean "correct" score (50.1%) from the mean score (44.9%) of subjects who studied nutrition as part of a college course. The mean "correct" score (38.5%) for students (N=131) who had never studied nutrition was not significantly different from the mean scores of students who had studied nutrition in junior or senior high school (N=71, 40.2%) or college (N=21, 44.9%). A statistically significant difference was determined, however, in the mean

TABLE XV

MEAN SCORES FOR "CORRECT" NUTRITION KNOWLEDGE ACCORDING TO SEX, FITNESS PARTICIPATION, PERCEIVED KNOWLEDGE, AND NUTRITIONAL BACKGROUND

Sex	Number	Mean Scores (%)[1]
Male	67	44.8 A[1]
Female	189	39.6 B[1]
Total	256	

Fitness Participation	Number[2]	Mean Scores (%)[1]
Yes	146	43.6 A[1]
No	109	37.5 B[1]
Total	255	

Perceived Knowledge	Number[2]	Mean Scores (%)[1]
Quite a bit	54	49.7 A[1]
A great deal	21	48.4 A[1]
Some	138	39.6 B[1]
Very little/none	42	30.1 C[1]
Total	255	

Nutritional Background	Number	Mean Scores (%)[1]
Other	33	50.1 A[1]
Have studied nutrition as part of a college course	21	44.9 A B[1]
Have studied nutrition in junior or senior high school	71	40.2 B[1]
Have never studied nutrition	131	38.5 B[1]
Total	256	

[1]Mean scores with unlike letters are significantly different ($p<0.05$).
[2]One subject failed to respond to the item.

"correct" scores of subjects who had never studied nutrition (38.5%) or had had nutrition in junior or senior high school (40.2%) and those who received their nutritional background from other sources (50.1%) (Table XV).

TABLE XVI

RESULTS OF ANALYSIS OF VARIANCE FOR "CORRECT" NUTRITION KNOWLEDGE SCORES

Source	DF	ANOVA SS	F Value	Observed Significance Level
Sex	1	1302.46	5.55	0.0192
Physical Fitness Participation	1	2344.50	10.13	0.0016
Perceived Knowledge	3	10127.99	16.68	0.0001
Nutritional Background	3	3909.86	5.76	0.0009

There was a significant difference in the mean "correct" nutrition knowledge scores associated with the variables of a) sex, b)physical fitness participation, c) perceived knowledge, and d) nutritional background at $p<0.05$ level; therefore, the researcher rejects H_3.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Summary

This study determined the nutritional knowledge as it relates to physical fitness of undergraduate students enrolled in a basic human nutrition course at Oklahoma State University. The difference in mean nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background were analyzed by the statistical technique, analysis of variance.

The review of literature included the areas of current American dietary trends, the role of physical fitness, nutritional guidelines for human performance, nutrition knowledge studies, and nutrition education. The literature review suggested the need for further research regarding nutritional knowledge as it relates to physical fitness. Information gained from this research would identify unfamiliar areas and misconceptions about nutrition as it relates to physical fitness; and, facilitate nutrition education planning in this area.

The sample consisted of undergraduate students enrolled in a basic human nutrition course (FNIA 1113) at Oklahoma

State University, Fall 1983. The researcher administered the instrument to the three class sections of FNIA 1113 during the last 20 minutes of the first class period, Fall 1983. As the instruments were completed, they were returned to the researcher. Of the 299 undergraduates enrolled in FNIA 1113, 256 students comprised the final sample.

From the data, frequencies and percentages were obtained to describe demographic and background information of the subjects. An analysis of variance statistical technique was used to determine if a significant difference existed in the mean nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background. Mean seperation was determined by Duncan's multiple range test at the $p<0.05$ confidence level.

The sample of 256 undergraduate students was comprised of 189 females and 67 males. Approximately 81 percent (80.9%) of the subjects ranged in age from 18 to 21 years with the largest percentage (27.7%) in the 18 to 19 age category. The majority of the sample, 69.9 percent, were classified as sophomores and juniors. A large percentage of subjects were enrolled in the College of Home Economics (66.0%) followed by the College of Arts and Sciences (27.0%). Of the major area of studies, 66.8 percent of the subjects identified with the College of Home Economics majors, or with other colleges on campus (28.1%). The other

category included majors in health professions, business, social sciences, education, and science.

Fifty-seven percent of the sample (N=146) regularly participated in a physical fitness activity, and 99.6 percent of the subjects (N=255) reported that the role of nutrition was very important or important as it relates to physical fitness. Approximately 70.3% (N=180) of the sample had some, little or no knowledge about the role of nutrition as it relates to physical fitness. This finding could be due to the fact that 51.2 percent of the subjects had never studied nutrition; and 196 (76.6%) subjects had no background in the area of nutrition as it relates to physical fitness. Of those who had a past nutritional background source related to physical fitness (N=51), four or more hours was the most frequent amount of time (27.5%) allotted to nutrition as it relates to physical fitness.

An interest in learning more about nutrition as it relates to physical fitness was indicated by 85.2 percent of the sample. Identified topics of interest were weight gain/loss (91.4%) and vitamin/mineral supplements (65.2%). The subjects' responses identified that parents (67.6%) and physicians/nurses (43.8%) were prime people sources of nutrition information. The sample also identified television (65.2%) and popular magazines (55.9%) as technological sources of nutrition information.

The research instrument contained 42 statements with true, false, or don't know responses. There were four

categories of nutrition knowledge: 1) macronutrients, 2) micronutrients, 3) energy and weight control, and 4) nutrition principles and meal patterns.

The ranges for the three different nutrition knowledge mean scores were 4.8 percent to 97.6 percent for the "perceived" mean scores; 33.3 percent to 100 percent for the "accurate" mean score; and 4.8 to 81.0 percent for the "correct" mean score. The mean score percentages for the sample were 59.6 percent, 68.9 percent, and 41.0 percent, respectively.

Nutrition information which the undergraduates were knowledgeable about dealt with combining diet and exercise for good health, alcohol as an energy source, basic four food groups, and balancing body weight through energy input and output. The subjects not only perceived they knew this nutritional knowledge, but also were accurate and correct.

The undergraduates had an inadequate knowledge of nutrition pertaining to protein, vitamins, carbohydrates and carbohydrate-loading, fluid needs, the pre-game meal, basic nutritional needs of athletes, dietary supplements, milk intake restriction, and gelatin, honey, and wheat germ.

Statistical analysis included analysis of variance, and Duncan's multiple range test for mean separation at $p<0.05$ confidence level. There was a significant difference in the mean "perceived" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background. A

significant difference existed in the mean "accurate" nutrition knowledge scores associated with a) sex and c) perceived knowledge; but no significance existed with b) physical fitness participation or d) nutritional background. There was a significant difference in the mean "correct" nutrition knowledge scores associated with the variables of a) sex, b) physical fitness participation, c) perceived knowledge, and d) nutritional background.

Results of this study indicated the following:

1. There was a lack of knowledge in the area of nutrition as it relates to physical fitness.
2. The perceived knowledge about nutrition as it relates to physical fitness was greater than the correct knowledge in this area.
3. Energy and weight control was the category of nutrition which the subjects were most knowledgeable about.
4. Macronutrients, micronutrients, and nutrition principles/meal patterns were categories of nutrition as it relates to physical fitness of inadequate knowledge.
5. Sex, physical fitness participation, perceived knowledge, and nutritional background significantly affected nutrition knowledge.
6. Nutrition is important in physical fitness was a common belief.

7. Parents and television were prime sources of nutrition information.
8. Weight control and vitamin/mineral supplements were topics of interest in the area of nutrition as it relates to physical fitness.

Implications

Based on the results of this study, the researcher has made the following implications:

1. Male undergraduates not only believed they knew more but actually had a higher "correct" mean score than females regarding nutritional knowledge as it relates to physical fitness. This could be due to the fact that males are more commonly involved in physical fitness or sports-related activities, and subjected to nutritional information, than the less active female.
2. Undergraduates who regularly participated in a physical fitness activity were more knowledgeable about nutrition as it pertains to physical fitness than non-exercisers. Individuals involved in physical activity tend to be concerned about diet's relationship to good health, or improved human performance. This may lead physical fitness participants to seek more reliable nutrition information sources.

Recommendations

The results of this study indicated that on the first day of classes, undergraduates enrolled in FNIA 113 lack basic nutrition knowledge especially as it pertains to physical fitness. Based on the results of the study, the researcher made the following recommendations:

1. A basic human nutrition course for undergraduate students should include a component on nutrition as it relates to physical fitness.
2. Nutrition education as it relates to physical fitness should be included in the academic preparation of all undergraduates either as a general education course or as a component of personal health.
3. Physical fitness participants and athletes should receive information about nutrition as it relates to human performance by qualified professionals.
4. Nutrition education related to physical fitness should include a basic study of the nutrients' sources and functions in conjuction with their practical application to human performance.
5. Educators, especially in home economics, nutrition, health, physical education and athletics, should address the topics of weight control and vitamin/mineral supplementation usage to their audiences.

6. In-service nutrition education programs with a unit regarding physical fitness need to be established for home economists/dietitians/ nutritionists, health professionals, and athletic coaches/trainers for professional continuing education.
7. As a Parent and Teacher Association topic, a nutrition as it relates to physical fitness seminar could be conducted for parents, teachers, and coaches with special emphasis on school sports.
8. Educational materials need to be developed that present valid nutrition information as it pertains to physical fitness; and be made available at health spas, athletic meets, coaching clinics, and professional conferences of home economists/ dietitians, coaches/trainers, and other health-related professionals.
9. Creative nutrition education strategies need to be presented through the mass media, especially television and popular magazines.
10. Nutrition education as it relates to physical fitness could be implemented through health education, K-12, in public schools.
11. More interdisciplinary courses and projects between the College of Home Economics and the School of Health, Physical Education, and Leisure

Science regarding nutrition as it relates to physical fitness should be offered to undergraduate students.

Suggestions

Further recommendations for additional research were made by the author to determine:

1. Differences in nutrition knowledge scores of undergraduates who have completed a basic human nutrition course and those undergraduates who have not completed a college-level basic human nutrition course.
2. If nutritional knowledge as it relates to physical fitness has an effect on the dietary practices/intake of individuals who are physical fitness participants and/or athletes.
3. The effect of a nutrition education unit as it pertains to physical fitness on the nutrition knowledge of athletes, coaches/trainers, health spa members, or health and physical education majors.
4. The nutrition knowledge as it relates to physical fitness of athletes, physical fitness participants, coaches/trainers, or health and physical education majors.
5. The effect age, class level, rural versus urban living, and race have on the nutrition knowledge of undergraduates.

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APPENDIXES

APPENDIX A

SURVEY INSTRUMENT

NUTRITION KNOWLEDGE AND PHYSICAL FITNESS SURVEY

ATTENTION
PLEASE COMPLETE BEFORE BEGINNING THE SURVEY:

Have you ever taken a college nutrition course before this course you are presently enrolled in? _____ YES _____ NO

If you answered YES, please turn in this survey immediately to your instructor!!!

If you answered NO, please continue to complete this survey. Thank you!

INSTRUCTIONS

This is a survey to determine information about nutritional knowledge related to physical fitness. It consists of two parts. Part I is the section on information about you. There are no right or wrong answers in this part. Read each question carefully and check (✓) the corresponding blank. Part II consists of some statements concerning nutrition and physical fitness. Read each statement carefully. Indicate whether you think the statement is true, false, or if you do not know. In the left hand column, circle "T" for true; "F" for false; or "DK" if you do not know the proper response. DO NOT GUESS!

FOR THIS SURVEY, "PHYSICAL FITNESS" IS DEFINED AS "BEING IN GOOD PHYSICAL CONDITION THROUGH PARTICIPATION IN PHYSICAL EXERCISE ACTIVITIES AND/OR ATHLETICS."

IT IS IMPORTANT THAT YOU ANSWER ALL ITEMS. YOUR RESPONSES WILL REMAIN ANONYMOUS AND YOU WILL NOT BE IDENTIFIED IN ANY MANNER.

Part I. Information About You

Directions: Please check (✓) the corresponding blank.

1. What is your current classification in college?

_____Freshmen _____Sophomore _____Junior _____Senior
_____Other: (please specify) _____

2. In what college are you enrolled at Oklahoma State University?

_____Agriculture
_____Arts and Sciences
_____Business Administration
_____Education
_____Engineering, Technology and Architecture
_____Home Economics
_____Veterinary Medicine
_____Other: (please specify)
_____

3. What is your major area of study?

_____Clothing, Textiles and Merchandising
_____Family Relations & Child Development
_____Food, Nutrition and Institution Administration
_____Home Economics Education and Community Services
_____Housing, Design and Consumer Resource
_____Hotel and Restaurant Administration
_____Other: (please specify)
_____
_____Undecided

4. What is your age range (in years)?

_____Under 18 _____18 - 19 _____19 - 20 _____20 - 21 _____Over 21

5. What is your sex? _____Female _____Male

6. Do you presently participate on a regular basis (3 or more times a week for a continuous time interval of 20 or more minutes) in a physical fitness activity, exercise, or sport?

_____YES _____NO

7. How important do you feel nutrition is to physical fitness?

_____Very Important _____Important _____Little Importance _____None _____No Opinion

8. What is your perceived knowledge about the role of nutrition in physical fitness?

_____A great deal _____Quite a bit _____Some _____Very little _____None

9. What is your past nutritional background?
_____Studied nutrition in junior or senior high school.
_____Studied nutrition as part of a college course.
_____Have never studied nutrition.
_____Other (Please specify):_____

10. Did your past nutrition background source include a segment on nutrition related to physical fitness?
_____YES _____NO

(IF YOU ANSWERED NO, SKIP QUESTION 11 AND PROCEED TO QUESTION 12)

11. If yes, how much total time of the course was allotted to the topic of nutrition related to physical fitness?

_____Less than 60 minutes (1 hour)
_____1 hour - 2 hours
_____2 hours - 3 hours
_____3 hours - 4 hours
_____More than 4 hours
_____Other: (please specify)
_____

12. From what person(s) have you received nutrition information? (You may check more than one, if applicable)

_____Athletic Coaches/Trainers
_____Dentist
_____Dietitians/Nutritionists
_____Druggists/Pharmacists
_____Friends/Classmates
_____Home Extension Agent
_____Home Economics Teachers
_____Parents
_____Physicians/Nurses
_____Sales person in a Health Food Store
_____Other: (please specify)
_____

13. From what additional source(s) have you obtained nutrition information? (You may check more than one, if applicable)

_____Cookbooks
_____Government publications
_____Food product labels
_____Popular books
_____Popular magazines, such as, Runner's World, Family Circle
_____Popular paperbacks on diet
_____Professional journals, such as, American Medical Association
_____Radio
_____Television
_____Textbooks
_____Other: (please specify)
_____

14. Are you interested in learning more about nutrition related to physical fitness?

_____YES _____NO _____NO OPINION

15. What specific topics are you interested in knowing more about? (Check all that apply)

_____Caloric Requirements of Athletes
_____Carbohydrates in the Athlete's Diet
_____Carbohydrate-Loading
_____Dietary Needs of Athletes
_____The Diabetic Athlete
_____Fat in the Athlete's Diet
_____Fluid Requirements
_____Non-Traditional Food Intake, such as, Vegetarianism
_____Pre-event Meals
_____Protein Needs of Athletes
_____Sports Anemia
_____Vitamin/Mineral Supplements
_____Weight Gain/Loss
_____Other: (please specify)
_____

Part II. Nutritional Knowledge Related to Physical Fitness Survey

DIRECTIONS: PLEASE READ EACH STATEMENT CAREFULLY. IF YOU THINK THE STATEMENT IS TRUE, CIRCLE THE "T". IF YOU THINK THE STATEMENT IS FALSE, CIRCLE THE "F". AND, IF YOU HAVE NO KNOWLEDGE OF THE STATEMENT OR UNCERTAIN OF THE CORRECT ANSWER, CIRCLE "DK" DO NOT GUESS.

ANSWER ALL ITEMS!!!

True	False	Don't Know		
			EXAMPLE: T (F) DK	Tea is the preferred pregame beverage.
T	F	DK	1.	During practice, athletes should avoid drinking water, but use crushed ice to quench thirst.
T	F	DK	2.	Decreasing caloric intake by 500 calories per day would mean a loss of about one pound of body weight per week.
T	F	DK	3.	Alcohol is recommended as a source of quick energy for the athlete.
T	F	DK	4.	Combining a nutritionally balanced diet with a sensible exercise program contributes to overall physical fitness.
T	F	DK	5.	Food sources rich in iron need to be emphasized in the diets of athletes, especially females and adolescent males.
T	F	DK	6.	Light pregame meals should be eaten about three to four hours before competition.
T	F	DK	7.	Protein intake not needed for body maintenance is stored in the body for later use.
T	F	DK	8.	The basic nutritional needs of athletes and nonathletes are the same except for calories.
T	F	DK	9.	Athletes engaged in severe and prolonged exercise (30 to 60 minutes) need to eat a diet high in protein.
T	F	DK	10.	Thirst is a good indicator of the athlete's need for water.
T	F	DK	11.	Athletes can increase their muscle power and relieve fatigue by eating wheat germ containing vitamin E.
T	F	DK	12.	Protein supplements are the most important food factors needed for building muscle mass.
T	F	DK	13.	Athletes should regularly supplement their diets with salt tablets.
T	F	DK	14.	Weight control involves balancing energy intake with energy output.
T	F	DK	15.	The major source of energy for the athlete is protein.
T	F	DK	16.	Large doses of vitamins are not harmful for the athlete.
T	F	DK	17.	The pre-competition meal should include some protein, a small amount of fat, and a liberal portion of complex carbohydrates.
T	F	DK	18.	Carbohydrates and fats are the two major nutrients used to supply energy to both the athlete and the nonathlete.
T	F	DK	19.	Fat consumed in the diet is a carrier of vitamins A, D, E, and K needed by both the athlete and nonathlete.
T	F	DK	20.	Athletes competing in sports of short duration will benefit from a carbohydrate-loading diet.
T	F	DK	21.	Fatty or fried foods in the diet should be limited in the pre-event meal of the athlete because they delay digestion.
T	F	DK	22.	Diets that contain fewer than 800 calories a day are hazardous to the health of the athlete.
T	F	DK	23.	Gelatin is an inexpensive high quality source of protein that is useful in building muscle in the athlete.
T	F	DK	24.	Honey is the best source of quick energy for the athlete.

True	False	Don't Know		
T	F	DK	25.	A diet which includes a variety of foods based on the Basic Four Food Groups is the the most sensible and safest way to guarantee an optimal intake of nutrients.
T	F	DK	26.	A moderate to low fat diet is recommended for both the athlete and nonathlete as a preventative measure against heart disease and obesity.
T	F	DK	27.	An eight ounce steak eaten in the pregame meal improves the performance of the athlete.
T	F	DK	28.	During meals, athletes should not drink water or other beverages.
T	F	DK	29.	Vitamin supplements are needed in the competitive athlete's diet even if the diet includes a proper variety of foods.
T	F	DK	30.	Simple carbohydrates (table sugar, honey, glucose) are preferred over complex carbohydrates (breads, cereals, grains) in providing energy to the athlete.
T	F	DK	31.	It is recommended that wrestlers and boxers reduce their weight through loss of body fat rather than loss of water from body cells and tissues.
T	F	DK	32.	Athletes should avoid drinking water during practice or training sessions.
T	F	DK	33.	Vitamin B_{15} supplementation is necessary for athletes due to their increased energy expenditure.
T	F	DK	34.	Bread and potatoes should be eliminated from the diets of training and competing athletes.
T	F	DK	35.	Excessive sugar or sweetners draw fluid into the digestive tract and contribute to the athlete's dehydration.
T	F	DK	36.	"Quick Energy" foods, such as honey, candy, and sweets, eaten before events of short duration improve performance.
T	F	DK	37.	There is no scientific evidence indicating that athletic performance can be improved by modifying a basically sound diet.
T	F	DK	38.	Special drinks containing water, sugar, and minerals such as Gatorade are necessary dietary supplements for the athlete.
T	F	DK	39.	Nutritionists recommend an average weight loss of five pounds per week as a realistic goal for the over-weight athlete.
T	F	DK	40.	When the athlete is no longer in training or competition, the caloric intake needs to be decreased.
T	F	DK	41.	Carbohydrate-loading is a dietary procedure in which high carbohydrate meals are used to build up muscle glycogen stores.
T	F	DK	42.	Milk intake should be restricted in the athlete's diet because it decreases the athlete's speed of movement.

THANK YOU! YOUR HELP AND COOPERATION ARE SINCERELY APPRECIATED

APPENDIX B

ANSWER KEY

ANSWER KEY TO NUTRITIONAL KNOWLEDGE AND PHYSICAL FITNESS SURVEY INSTRUMENT

True - False - Don't Know

1. False
2. True
3. False
4. True
5. True
6. True
7. False
8. True
9. False
10. False
11. False
12. False
13. False
14. True
15. False
16. False
17. True
18. True
19. True
20. False
21. True
22. True
23. False
24. False
25. True
26. True
27. False
28. False
29. False
30. False
31. True
32. False
33. False
34. False
35. True
36. False
37. True
38. False
39. False
40. True
41. True
42. False

VITA

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Candidate for the Degree of

Master of Science

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