AN ABSTRACT OF THE THESIS OF

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Title: Analysis of Resistance Exercise Curriculum in Select Four-Year Undergraduate Physical Education Programs

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The purpose of this study was to determine whether differences exist in the level of coverage of resistance exercise in select four-year college and university undergraduate physical education programs. The study also examined whether differences exist between content suggested for training resistance exercise specialists and the curriculum being offered. A final dimension of the study was to identify existing program options with an emphasis on resistance exercise. The objective was to identify information that might be applied by college and university-level curriculum specialists for the development of resistance exercise related courses. The survey instrument (a mailed questionnaire) was developed by integrating the NSCA role delineation study (1988) and a study of the literature related to resistance exercise. A panel of specialists was employed to expand, modify, and validate the instrument. Twelve categories and 91 content areas were identified.

The study population was comprised of 76 National Strength and Conditioning Association (NSCA) members who were listed under undergraduate physical education programs in the Physical Education Gold Book. Of the 76 members contacted, 63 (83%) completed and returned the questionnaire. The findings of the study showed that differences do exist in the level of coverage of resistance exercise in the curriculum of four-year undergraduate physical education programs. The three categories with the most consistently high coverage were Muscle Physiology, Biomechanics, and Testing and Evaluation. The three categories with the most consistently low level of coverage were Administration/Organizational Concerns, Special Populations, and Methods Used to Develop Strength. The content areas with the most consistently high level of coverage were Dynamics of Contraction, Movement Terminology, Body Mechanics, Lactic Acid Metabolism, and Modes of Strength Training. The content areas receiving the most consistently low level of coverage were Legal Issues, and Functional Isometrics.

ANALYSIS OF RESISTANCE EXERCISE CURRICULUM IN SELECT FOUR-YEAR UNDERGRADUATE PHYSICAL EDUCATION PROGRAMS

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CHAPTER 1

INTRODUCTION

"In a dramatic shift that's sweeping the nation, people of all ages are now being encouraged to take up weight lifting or what's called strength training" (American Broadcasting Corporation, 1991). A more accurate term to describe resistance forms of exercise, such as weight lifting, strength training, power lifting, weight training, circuit weight training, isometrics, and isokinetics, is that of resistance training (Vogel, 1988). Resistance training has been one of the fastest growing physical activities in terms of participation and facility expansion in the United States since the 1980s (Berg, 1990; Staff, 1983).

Systematic resistance exercise has been shown to increase levels of muscular strength and endurance. It is routine in programs of health related exercise and extensively used in occupational, recreational, and sports training (Blair, 1988). Numerous studies and medical symposiums have been conducted to facilitate a better understanding of the impact that different resistance exercise prescription variables have on the individual. However, it has been noted that the understanding of resistance exercise may not be keeping up with the prodigious participant involvement (Stewart, 1989; Vogel, 1988).

In regard to the physiological processes and adaptive mechanisms associated with resistance exercise, comparatively few written reviews exist; greater comprehension of the impact that divergent exercise prescription variables have on physiological responses and adaptation is needed (Vogel, 1988). Fleck and Kraemer (1988a) observe that confusion exists as to the benefits and recommendations for individuals who are implementing programs involving resistance exercise.

Need for the Study

Today, because of the popularity and involvement of participants in resistance exercise, many of our nation's college and university physical education students upon graduation are placed in work experiences requiring them to teach, demonstrate, and prescribe exercise involving resistance training. The reported lack of understanding emphasizes how important it is to determine the resistance exercise content and level of coverage being incorporated into college and university undergraduate physical education programs that are training specialists to work with and prescribe resistance exercise. To date, no formal assessment of undergraduate physical education curriculum involving resistance exercise at four-year colleges and universities has been conducted. It is necessary to evaluate whether the content being taught corresponds to the content that has been identified as essential to the knowledge base suggested for the resistance exercise specialist.

Statement of the Problem

Without examining the preparatory coursework offered by four-year undergraduate physical education programs, by an evaluation of the level of coverage and a comparison of content suggested for resistance training specialists, it is difficult to know how college and universities are preparing students to work in settings utilizing resistance exercise.

Purpose of the Study

The purpose of this study was to: (a) determine whether differences exist in the level of coverage in preparatory coursework content offered by select four-year college and university undergraduate physical education programs regarding resistance exercise; (b) note whether differences exist between content suggested for training resistance exercise specialists and the curriculum being offered; and (c) identify existing program options with an emphasis on resistance exercise. The information collected may be useful to college and university-level curriculum specialists in the development of resistance exercise-related courses.

Definition of Terms

Biochemistry: The chemistry of living things; the science of the chemical changes accompanying the vital functions of plants and animals (Thomas, 1985).

Bioenergetics: The study of energy transfer and relationships between all living systems (Thomas, 1985).

Biomechanics: The application of mechanical forces to living organisms. Includes forces that arise from within and outside the body (Thomas, 1985).

Cardiovascular: Pertaining to the heart and blood vessels (Thomas, 1985).

Exercise: Any and all activity involving generation of force by the activated muscle(s) (Komi, 1991).

Exercise physiology: The study of body function during exercise (Brooks, 1984).

Exercise prescription: An individual program of exercise based on an individual's level of fitness and health status; exercise intensity (e.g., percentage of maximum heart rate or rating of perceived exertion), frequency per week (e.g., three times/week), duration (e.g., 30 min/session), and mode (e.g., jogging), should be considered (Anshel, 1991).

Force: An action (push or pull), that causes a change in the state of motion of an object and its linear acceleration. Force is measured in newtons (N) (Anshel, 1991).

Free weight: An object of known mass, not attached to a supporting or guiding structure, which is used for physical conditioning and competitive lifting (Komi, 1991).

Neuroendocinology: Study of the relationship between the nervous and endocrine systems (Thomas, 1985).

Neuromuscular: Concerning both nerves and muscles (Thomas, 1985).

Physiology: The science of the functions of the living organism and its components and the chemical and physical processes involved (Thomas, 1985).

Power: The rate of performing work; the product of force and velocity. The rate of transformation of metabolic potential energy into work or heat. Power is measured in watts (W) (Komi, 1991).

Powerlifting: The competitive sport which contests utmost lifting ability in the squat, bench press, and deadlift for one repetition maximum.

Resistance device: Any instrument that provides resistance to muscle actions and can be used as a strength training device (Anshel, 1991).

Resistance training: Any method or form of exercise used to resist, overcome or bear force (NSCA, 1985).

Strength: The force a muscle group can apply against a given resistance. The force exerted is typically determined by one maximal effort or one repetition maximum (RM) (Blair, 1988).

Strength endurance: The ability of the muscle group to sustain repeated contractions of a given force for an extended period of time (Blair, 1988).

Strength training: The use of resistance methods to increase one's ability to exert or resist force. The training may utilize free weights, the individual's own body weight, machines, and/or other devices to attain this goal. In order to be measurably effective, the training

sessions must include timely progressions in intensity, which impose sufficient demands to stimulate strength gains that are greater than those associated with normal growth and development (NSCA, 1985).

Training: Regular exercise over an extended period of time (months, years, etc.) (Stone & O'Bryant, 1987).

Weightlifting: The competitive sport which contests utmost lifting ability in the olympic snatch and the clean and jerk for one repetition maximum.

Weight training: The use of free weights, weight stacks, or body weight (Stone & O'Bryant, 1987).

CHAPTER 2

REVIEW OF LITERATURE

Exercise Science

The science of exercise had its beginnings in Europe with the work of August Krogh of Denmark (The August Krogh Institute), A. V. Hill of Britain, and Otto Meyerhof of Germany (Powers & Howley, 1990).

During the early twentieth century, the Carnegie Foundation commissioned studies on the energetics of muscular exercise (Brooks, 1984). The focal point of exercise science history in the United States was the establishment of the Harvard Fatigue Laboratory, which existed from 1927 to 1947 under the direction of Dr. David Bruce Dill. The laboratory was responsible for the developing many of the techniques used today in testing physiological parameters and for providing the world with many of its great exercise physiologists (Powers & Howley, 1990).

Numerous organizations have evolved to meet the needs of various populations with regard to exercise science. Among these organizations are the American College of Sports Medicine, National Strength and Conditioning Association, American Alliance for Health, Physical Education, Recreation and Dance, the United States Olympic Committee, and President's Council on Physical Fitness and Sports.

Fox, Bowers, and Foss (1989) note that it is necessary for coaches, trainers, physical educators, and fitness instructors to recognize the role that science has had in determining the outcome of physical education, athletic, and activity programs. Exercise physiology has evolved into a discipline that involves all of the so called "hard" sciences of physics, chemistry, and biology/physiology. It encompasses such areas of study as bioenergetics, neuromuscular concepts, motor learning, cardiorespiratory concepts and exercise, nutrition and body composition, biomechanics, and resistance exercise. An understanding of exercise science provides a solid knowledge base for exercise prescription enabling practitioners to know why a certain approach would be selected for achieving a specific task (Fox et al., 1989).

> The study of strength and power is one of the major components of sports science, and an understanding of the relationships between neural, hormonal, muscular and mechanical factors is central to athletic performance as well as to strength and power needs of other human populations (Komi, 1991, preface).

Resistance Exercise

Resistance exercise involvement can be traced back thousands of years through numerous cultures and early civilizations. Ancient Greeks and Romans applied strength training and conditioning in preparing for athletic competition and warfare. So prodigious was the participant involvement in Greece that weightlifting has been credited as being the most characteristic exercise of the sixth century (Gardiner, 1930; Robinson,

1955). According to Gardiner (1910), the Olympic champion Milo of Crotona (circa 500 B.C.) was one of the earliest to implement resistance training theory with the application of progressive overload: he lifted and carried a young bull calf every day till it was fully grown. The Renaissance (A.D. 1300-1500) also brought forth written documentation on the use of resistance training as a way to improve health, strength, and assure superiority in combat (Leonard, 1927).

Resistance exercise was being practiced on the North American continent as early as 1786. U.S. statesman Benjamin Franklin is reported to have participated in an extended program of resistance exercise (Van Doren, 1938). In the early 1930s, a number of individuals began to emphasize the need for strength in athletic performance, and prominent athletes of the day began to lift weights. In 1956, the first book to directly apply a weight training program to sport activity was published (Van Dalen & Bennett, 1971). However, prior to the early 1950s, U. S. coaches of almost all sporting activities regarded weight resistance training with contempt. The accepted theory was for athletes to practice only their own sport and to conserve energy. It was thought that intermingling other sports or activities might adversely affect the athlete's physical and overall sport performance. Cycling was associated with muscle stiffening, swimming with the potential to devitalize the musculature. Most precluded of all was weight lifting; it was credited with inducing muscleboundness and slowing reaction time (Van Dalen & Bennett, 1971). In conducting a survey of

mainstream sports and training books published during the first 60 years of this century, Todd (1985) found that most either maligned weight training or neglected it altogether.

The myths surrounding weight resistance exercise were virtually dispelled by research in the 1950s and 1960s which documented that resistance exercise enhanced muscular strength while maintaining or increasing movement speed and flexibility. In longitudinal experiments with untrained healthy subjects, resistance exercises were found to increase both speed and power of muscular effort. This information paired with the extraordinary joint flexibility that is exhibited by elite weight lifters demonstrated that the effects of resistance exercise would not be deleterious to and, in fact, would enhance sport and physical performance (McArdle, Katch & Katch, 1981). Today, the accumulation of research has prompted major medical organizations such as the American College Sports Medicine (ACSM) (1990) to include resistance exercise in their recommendations for a balanced program of exercise for the healthy adult.

Professional Organization/Certification

In 1978, a nonprofit educational association, the National Strength and Conditioning Association (NSCA), was founded with 75 charter members. The mission statement of the National Strength and Conditioning Association is to "bridge the gap between sport science research and its application in conditioning athletes to levels of optimum performance" (NSCA, 1990).

Professional testing and certification for strength and conditioning was implemented in 1985 with the inception of the Certified Strength and Conditioning Specialist (CSCS) program by the NSCA. The certification examination was designed to ensure a minimum level of competence among practitioners and, thereby, create an appropriate standard of care for the strength and conditioning of athletes.

In 1988, a Role Delineation Study was conducted by an NSCA Criterion Reference Testing Task Force Committee and Columbia Assessment Services, Inc., to identify the most appropriate content for the certification examination for entry-level strength and conditioning specialists. The content areas (major performance domains) identified by the committee were exercise science, program design, exercise technique, testing and evaluation, nutrition, and organization and administration. Each performance domain was broken down into distinct tasks (identifiable work activities) and the knowledge and skills thought necessary to cover the

spectrum of professional activities and the principle areas of responsibility for strength and conditioning specialists.

A representative group of 1,000 members of the National Strength and Conditioning Association were asked to evaluate the performance domains developed by the Task Force (NSCA, 1988). The homogeneity of responses further validated those areas identified by the committee. The respondents ranking of the domains agreed with that of the Task Force with the exception of the domain of exercise science: the respondents ranked knowledge in this domain as more important than did the Task Force. The ranking of the domains obtained from the study were converted to percentages to determine the number of test questions in each domain of the Certified Strength and Conditioning Specialist examination (NSCA, 1988).

Domain	Percent
I. Program Design	23
II. Exercise Techniques	31
III. Organization and Administration	19
IV. Testing and Evaluation	11
V. Exercise Sciences	11
VI. Nutrition	6
	100

Each domain in the NSCA Role Delineation Study was broken down into a number of specific tasks that were written by the Task Force to identify the specific work activities related to the domain. Further, knowledge and skills integral to each task were identified by the Task Force.

The survey categories and content areas used in the present study were primarily formulated using the domains and tasks identified in the NSCA (1988) Role Delineation Study. For example, the following survey categories and content areas were formulated utilizing the tasks and knowledges in the NSCA domain of Exercise Science:

Survey category - Muscle Physiology.

Survey Content Area - Muscle Structure, Attachment/Arrangement of Fibers, Dynamics of Contraction.

Task 1. To demonstrate an understanding of human muscle physiology in order to appropriately design exercise programs.

Knowledges:

1. Knowledge of the anatomy of muscle microstructure and macrostructure.
2. Knowledge of contraction dynamics and definitions (e.g., sliding filament theory, eccentric, isotonic).
3. Knowledge of contraction theory.
4. Knowledge of movement definitions (e.g., flexion, extension) (NSCA, 1988, p. 43).

Survey Category - Bioenergetics Relative to Resistance Exercise.

Survey Content Area- Biological Energy Systems Relative to Resistance Exercise, Metabolic Costs of Resistance Exercise, Glycogen Utilization, Lactic Acid Metabolism, Carbohydrate Metabolism, Amino Acid and Protein Metabolism/Needs, Lipid Metabolism.

Task 2. To be able to demonstrate an understanding of human bioenergetics and metabolism so that training programs are designed specific to the activity.

Knowledges:

1. Knowledge of energy systems.
2. Knowledge of human metabolism (e.g., substrate utilization).
3. Knowledge of recovery mechanisms (e.g., glycogen replenishment, exercise: rest ratio) (NSCA, 1988, p. 44).

Survey Category - Neuroendocrinology Relative to Resistance Exercise.

Survey Content Area- Hormonal Response/Regulation.

Task 3. To demonstrate factual knowledge about neuroendocrine responses to physical activity so that appropriate training programs are designed to obtain the desired results.

Knowledges:

1. Knowledge of basic neuroendocrinology.
2. Knowledge of the effects of exercise on the neuroendocrine system.
3. Knowledge of the neuroendocrine response to exercise (acute and chronic) (NSCA, 1988, p. 45).

Survey Category - Neuromuscular Aspects Relative to Resistance Exercise.

Survey Content Area- Neuromuscular Anatomy and Physiology, Motor Unit Recruitment Patterns, Neuromuscular Adaptation to Resistance Exercise.

Task 4. To be able to apply knowledge of neurological adaptations to training so that safe and effective training programs can be designed for individuals.

Knowledges:

1. Knowledge of basic neuromuscular anatomy and physiology (e.g., motor units).
2. Knowledge of motor unit recruitment patterns during exercise (e.g., size principle, summation).
3. Knowledge of the role of proprioceptors in learning physical skills (e.g., muscle spindle fibers).
4. Knowledge of muscle fibers and their adaptation to training (e.g., fiber enlargement) (NSCA, 1988, p. 46).

Survey Category - Cardiovascular Response Relative to Resistance Exercise.

Survey Content Area- Effect of Resistance Exercise on the Heart, Effect of Resistance Exercise on Blood Pressure, Effect of Resistance Exercise on Serum Lipid Profiles, Effect on the Peripheral Vascular System.

Task 5. To demonstrate an understanding of cardiovascular anatomy and physiology at rest and in response to various forms of exercise so that appropriate and effective exercise programs can be designed for individuals.

Knowledges:

1. Knowledge of cardiovascular anatomy and physiology.
2. Knowledge of respiratory anatomy and physiology.
3. Knowledge of cardiovascular and respiratory responses to different forms of exercise (acute and chronic) (NSCA, 1988, p. 47).

Survey Category - Training Principles/Theory and the Application to Resistance Exercise.

Survey Content Area- Injury Prevention, Specific Adaptation to Imposed Demands.

Task 6. To understand the adaptation of bone, muscle and connective tissues, and to apply this knowledge in program design so that the potential for injury to the individual is reduced and the probability of enhanced performance is increased.

Knowledges:

1. Knowledge of the effects of different forms of exercise on bones.
2. Knowledge of the effects of different forms of exercise on muscles (e.g., hypertrophy, atrophy).
3. Knowledge of the effects of different forms of exercise on connective tissue (NSCA, 1988, p. 48).

Survey Category - Biomechanics of Resistance Exercise.

Survey Content Area- Movement Terminology, Body Mechanics.

Task 7. To demonstrate an understanding of muscle and skeletal anatomy and to apply the basic principles of the biomechanics of human movement in order to select appropriate exercises and promote the safe effective and proper execution of them.

Knowledges:

1. Knowledge of the laws of physics as they apply to human movement (e.g., action-reaction).
2. Knowledge of lever systems as they apply to human movement.
3. Knowledge of movement descriptions (e.g., flexion, abduction).
4. Knowledge of the role of muscles in movement (e.g., agonist, synergist) (NSCA, 1988, p. 49).

Survey Category - Special Populations (Training Considerations).

Survey Content Area- Gender Similarities/Differences, Elderly.

Task 8. To construct individual programs to account for biomechanical or physiological differences due to unique characteristics of the individual (i.e., age, gender, training status).

Knowledges:

1. Knowledge of anatomical and physiological gender differences.

2. Knowledge of the effects of aging on performance.

3. Knowledge of the role of training status on exercise programs (e.g., untrained vs. trained) (NSCA, 1988, p. 50).

Survey Category - Exercise Prescription.

Survey Content Area- Estimation of Workload, Methods of Varying Intensity, Frequency of Exercise, Duration of Exercise, Exercise Selection, Exercise Order, Sets, Repetitions, Exercise Speed, Recovery/Restoration.

Task 9. To recognize acute and chronic physiological responses and adaptations to training and their implications to the design of sport specific training programs.

Knowledges:

1. Knowledge of acute and chronic responses to anaerobic training.

2. Knowledge of acute and chronic responses to aerobic training.

3. Knowledge of factors that characterize or influence overtraining.

4. Knowledge of various recovery techniques (e.g., active vs. passive warm down).

5. Knowledge of the effects of detraining (NSCA, 1988, p. 51).

Survey Category - Bioenergetics Relative to Resistance Exercise.

Survey Content Area- Nutritional Alternatives to Anabolic Steroids, Supplements.

Task 10. To demonstrate factual knowledge of performance enhancing substances and to provide persuasive evidence to individuals as to the effects, risks, and appropriate alternatives.

Knowledges:

1. Knowledge of various performance enhancing substances and their effects on performance.

2. Knowledge of hormonal therapy (e.g., hGh, testosterone and thyroid), and anabolic steroids (e.g., NSCA position paper on steroid use).

3. Knowledge of various dietary supplements (e.g., multivitamin, iron) (NSCA, 1988, p. 52).

The remaining categories were formulated using the other four NSCA Role Delineation Study domains:

NSCA Domain	Category
Program Design	Training Principles/Theory and Application to Resistance Exercise
Exercise Techniques	Methods Used to Develop Strength and its Components/Exercise Technique
Testing and Evaluation	Testing and Evaluation
Organization and Administration	Administration/Organizational Concerns

Content areas that were not specifically designated in the NSCA Role Delineation Study were drafted after a review of literature pertaining to resistance exercise (Vogel, 1988; Stewart, 1989; Jones, McCartney, & McComas, 1986; Fleck & Kraemer, 1987; Stone & O'Bryant, 1987; Fleck & Kraemer, 1988a, 1988b, 1988c, 1988d; Komi, 1991).

Academic Preparation

> The field of exercise physiology is at the dawn of a new era. Recent advances in microscopic and biochemical techniques, aided by computerized technology, are opening up new frontiers in subcellular architecture, function, and adaptation to exercise and training. A cross-discipline thrust will hopefully begin to unravel the many unanswered secrets relating to the elite performer, as well as to a large segment of the population that is increasing its appreciation for involvement in sport and exercise (McArdle, Katch, and Katch, 1981).

Powers and Howley (1990) affirm that the undergraduate preparation in physical education has transformed over the past two decades to represent the scientific knowledge base that is essential to deal with the issues related to fitness, performance, and skill acquisition. Although strength development has been widely recognized as a major component of sport science and fitness (Blair, 1988; Heyward, 1991; Howley & Franks, 1986; Komi, 1991), concern has been expressed regarding the preparation of individuals who are implementing programs involving resistance exercise (Fleck & Kraemer, 1988d; Pullo, 1992; Vogel, 1988).

Pullo (1992) contends that professionals with the needed academic training, qualifications, and experience are essential in preparing individuals for superior performance and for injury prevention, yet few colleges and universities provide the formal academic training for individuals who aspire to become strength and conditioning specialists at the collegiate level. In an endeavor to investigate the status of master degree programs in strength training and conditioning in the United

States, Smith (1988) identified only five academic institutions sponsoring such programs and recommended additional longitudinal study to assist in identifying any future changes in these programs and their number. By comparison, there are 86 undergraduate/graduate accredited college and university athletic training curriculum programs currently available, involving some 2,300 students and producing over 9,500 certified athletic trainers (National Athletic Trainers Association, 1991).

Smith (1988) notes that research of existing undergraduate programs involving resistance exercise is needed to understand the curriculum necessary for this particular area of specialization. Currently in the United States, no formal assessment has been conducted which identifies, evaluates, and/or accredits college and university institutions sponsoring undergraduate program curriculum involving resistance exercise.

With each passing decade, changes continue to take place in the exercise and fitness habits of the American people. Physical fitness appears to have gained a place of high priority in the scheme of everyday living. Millions of men and women are now actively engaged in cycling, running, jogging, swimming and weight training (Berg, 1990). Fitness centers, athletic clubs, and corporate fitness programs have proliferated and become an integral part of day to day life. Keeping pace with these changes are major scientific advances in exercise physiology and sports medicine. A great deal of knowledge presently is available in such diverse areas as exercise testing and evaluation, cardiorespiratory functioning and

aerobic fitness, muscle physiology and strength development, and nutrition. Following a review of literature pertaining to college curriculum in exercise and sport science, few colleges and universities seem to adequately prepare undergraduate students in the area of applied resistance exercise. Without appropriate academic preparation in strength physiology students are unable to write and establish science based strength fitness programs. A knowledge base in strength physiology allows the student to implement exercise prescriptions that will not only fulfill the needs of athletic populations but also design programs that recognize the growth and developmental needs of adolescents, and the necessity to maintain functional levels of strength throughout each decade of life.

Summary

To date there has been a scarcity of literature related to curriculum content at the college and university level in exercise and sports science regarding resistance exercise and strength development. Based upon the review of literature there is a critical need to survey present curriculum content in this area. The data generated from this study can serve as a guide in bringing about meaningful curriculum changes that reflect current research based upon scientific concepts of strength training and beneficially incorporate the findings of the National Strength and Conditioning Role Delineation Study.

CHAPTER 3

METHODOLOGY AND PROCEDURES

The present study examined the resistance exercise curriculum in select four-year college and university undergraduate physical education programs. This chapter describes the population of the study, the development of the research instrument, specialist panel selection, method and collection of data, and statistical treatment of data.

The Population

The population for this study were 76 National Strength and Conditioning Association (NSCA) members who were identified at undergraduate physical education programs at four-year colleges and universities in the Physical Education Gold Book (1987-1989).

Development of the Research Instrument

The data-gathering instrument employed in this study (Appendix F) was a mailed, self-administered questionnaire comprising three sections.

Section I listed 91 content areas in 12 categories related to resistance exercise. Respondents were asked to indicate, on a Likert-type 4-point scale, what degree of coverage the content areas have in their undergraduate curriculum. Content areas were established by a review of related literature and were subject to revision and consensus agreement by

a panel of specialists. The panel of specialists was utilized to augment, modify, and ensure content validity of the instrument (Linstone, 1975). Section II requested respondents to indicate whether their undergraduate program contained an option with an emphasis on resistance exercise and, if so, to list the program option title. Section III encouraged respondents to make any supplemental comments they deemed important regarding the topics covered in the questionnaire and to list any additional areas that they believed should be included in the curriculum. Asking respondents for comments regarding the topics covered and requesting that they list any additional areas they believe should be included served to provide further appraisal of the content validity of the instrument (Sommers, 1991).

Specialist Panel Selection

As recommended by Samahito (1984), six (6) individuals comprised the specialist panel. The panel members were acknowledged specialists who were currently directing academic, commercial, and athletic exercise programs and/or instruction involving resistance exercise (Appendix A).

Collection of Data

The data collection strategy utilized during this study followed the research methods developed by Dillman (1978) for mail surveys. The initial mailing included a cover letter, research instrument (questionnaire), and postage-paid business reply envelope. The subjects were asked to complete

and return the questionnaire on or before March 13, 1992. Subjects were assured of complete confidentiality (that their name or that of their institution would not be placed on the questionnaire), and that the identification number on the questionnaire was for follow-up mailing purposes only. The initial mailing was followed one week later by a post-card which thanked those who had returned the instrument and exhorted those who had not to do so. The first follow-up letter and replacement questionnaire to non-respondents was mailed three weeks after the initial mailing, noting the significance of the subjects' involvement in the project and encouraging them to complete and return the questionnaire. A second follow-up letter and replacement questionnaire to nonrespondents was mailed five weeks after the initial mailing. April 10th was selected as the cutoff date to include returned questionnaires in the study.

The following schedule was used for project distribution:

February 27, 1992:	Initial mailing: Cover letter (Appendix B) and questionnaire (Appendix F)
March 5, 1992:	Follow-up postcard (Appendix C)
March 19, 1992:	First letter follow-up (Appendix D) and replacement questionnaire to non-respondents.
March 31, 1992:	Second letter follow-up (Appendix E) and replacement questionnaire to non-respondents.

Statistical Treatment of Data

Returned instruments were assigned a code number, and the content areas of Section I were entered into a data base so that the SPSS/PC+ V3.0 computer program could be utilized. Frequency distributions were computed and means, medians, and standard deviations were calculated to summarize the responses to each of the 91 content areas. The 12 categories were ranked by mean to examine central tendency and then ranked by standard deviation to examine variability across institutions.

The undergraduate program options with an emphasis on resistance exercise (Section II) were identified and the program option titles listed.

Section III encouraged respondents to make any supplemental comments they deemed important regarding the topics covered in the questionnaire. In addition, respondents were asked for comments regarding the topics covered, requesting that they list any additional areas they believed should be included. This served to obtain further appraisal of the content validity of the instrument.

CHAPTER 4

RESULTS

The purpose of this study was to: (a) determine whether differences exist in the level of coverage in preparatory coursework content offered by select four-year undergraduate physical education programs regarding resistance exercise; (b) determine whether differences exist between content suggested for training resistance exercise specialists and the curriculum being offered; (c) identify existing program options with an emphasis on resistance exercise.

Population

The population for this study was comprised of NSCA members listed under undergraduate physical education programs in the Physical Education Gold Book (1987-1989). Seventy-six public and private institutions, representing forty states were contacted for participation in the study.

Response Rate

The response rate for this study was 83 percent. Name recognition of the investigators may have positively impacted return rate. Application of the aspects of the survey process identified in the TDM (total design method) as affecting response quantity or quality also may have encouraged the high

response rate. Dillman (1978) observed that failure of mailed surveys to elicit satisfactory results (return response) occurs as often from poor administration as from poor design. TDM identifies factors that increase response behavior and facilitate survey implementation. None of the studies Dillman reviewed reported a response rate of less than 50 percent, "a level once considered quite acceptable for mail surveys" (p. 21). While Oregon State University's Survey Research Center suggests that a response rate of 67 percent is typical for mail surveys (Nielsen, 1989), the average response rate obtained when implementing TDM is 74 percent.

Analysis of Data

Section I

Frequency distributions were computed and means, medians, and standard deviations were calculated to summarize the responses to each of the 91 content areas. The 12 categories were ranked by mean to examine central tendency and then ranked by standard deviation to examine variability across institutions.

The results of the category ranking show variability among the categories and content areas with respect to level of coverage. Of the 12 categories, 5 categories (Administration/Organizational Concerns, Special Populations, Methods to Develop Strength, Neuroendocrinology, and Cardiovascular Responses) averaged "little to moderate" coverage across institutions for the study. The remaining 7 categories (Neuromuscular

Aspects, Training Principles, Exercise Prescription, Bioenergetics, Testing and Evaluation, Muscle Physiology, and Biomechanics) averaged "moderate to extensive" coverage. The category of Administration/ Organizational Concerns was ranked lowest in coverage, while Biomechanics was ranked highest in coverage (Figure 1).

An overall indication of coverage can be determined by examining the level of coverage (mean) together with the variability (standard deviation) across institutions. A high level of coverage with little variability indicates overall, a consistently high level of coverage. Similarly, a low level of coverage with little variability indicates an overall consistently low level of coverage.

Muscle Physiology was found to have the least variability in coverage across institutions and the second highest coverage of all the categories. This would seem to indicate that Muscle Physiology has the most consistently high level of coverage. Contrast this with the category of Administration/Organizational Concerns, which ranked lowest in coverage and had a "moderate to high" level of variability, indicating overall a consistently low level of coverage (Figure 2).

In terms of consistency of coverage, the data indicate that the three categories with the most consistently high coverage were Muscle Physiology, Biomechanics, and Testing and Evaluation.

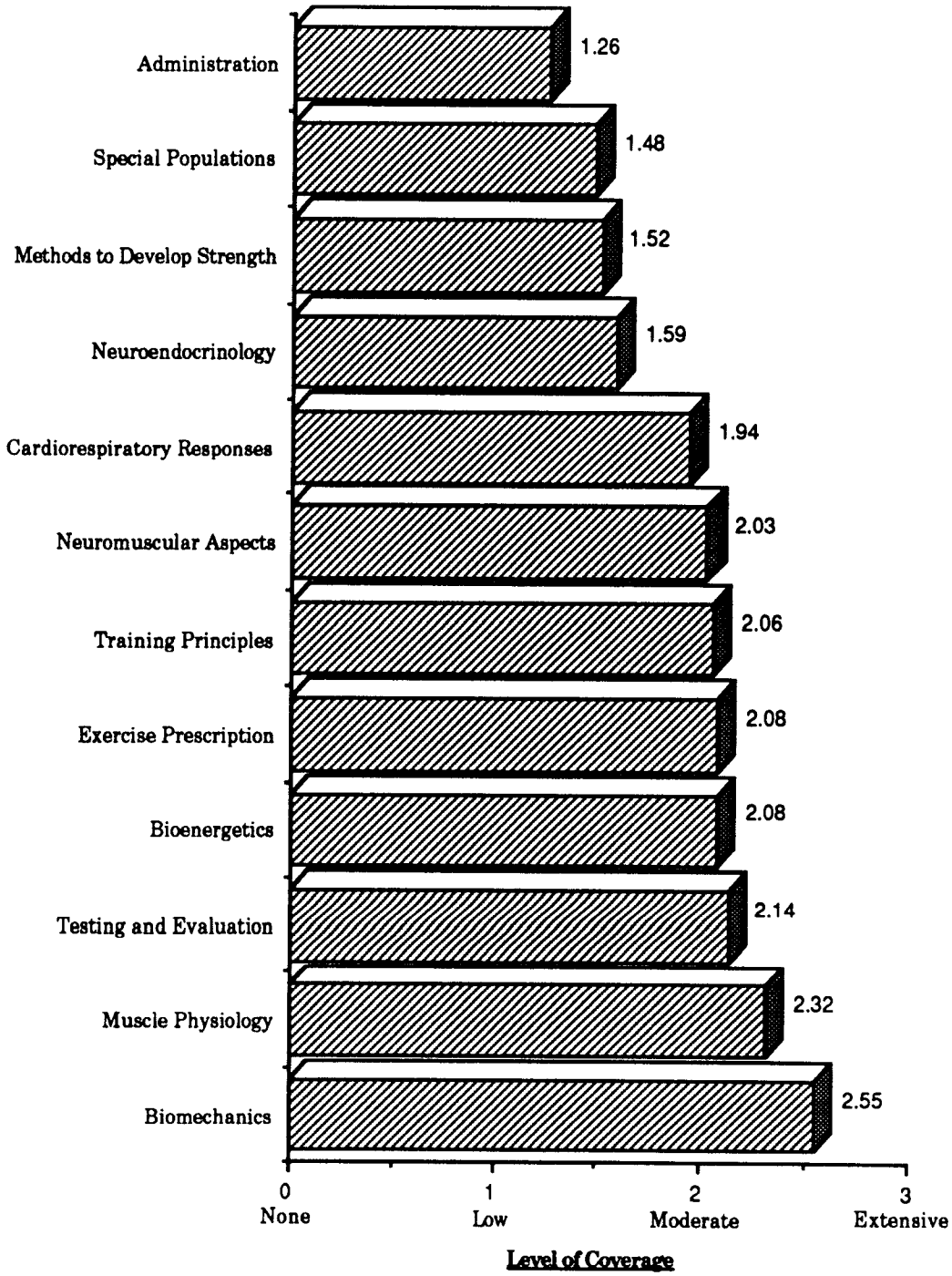

Figure 1. Categories ranked by level of coverage.

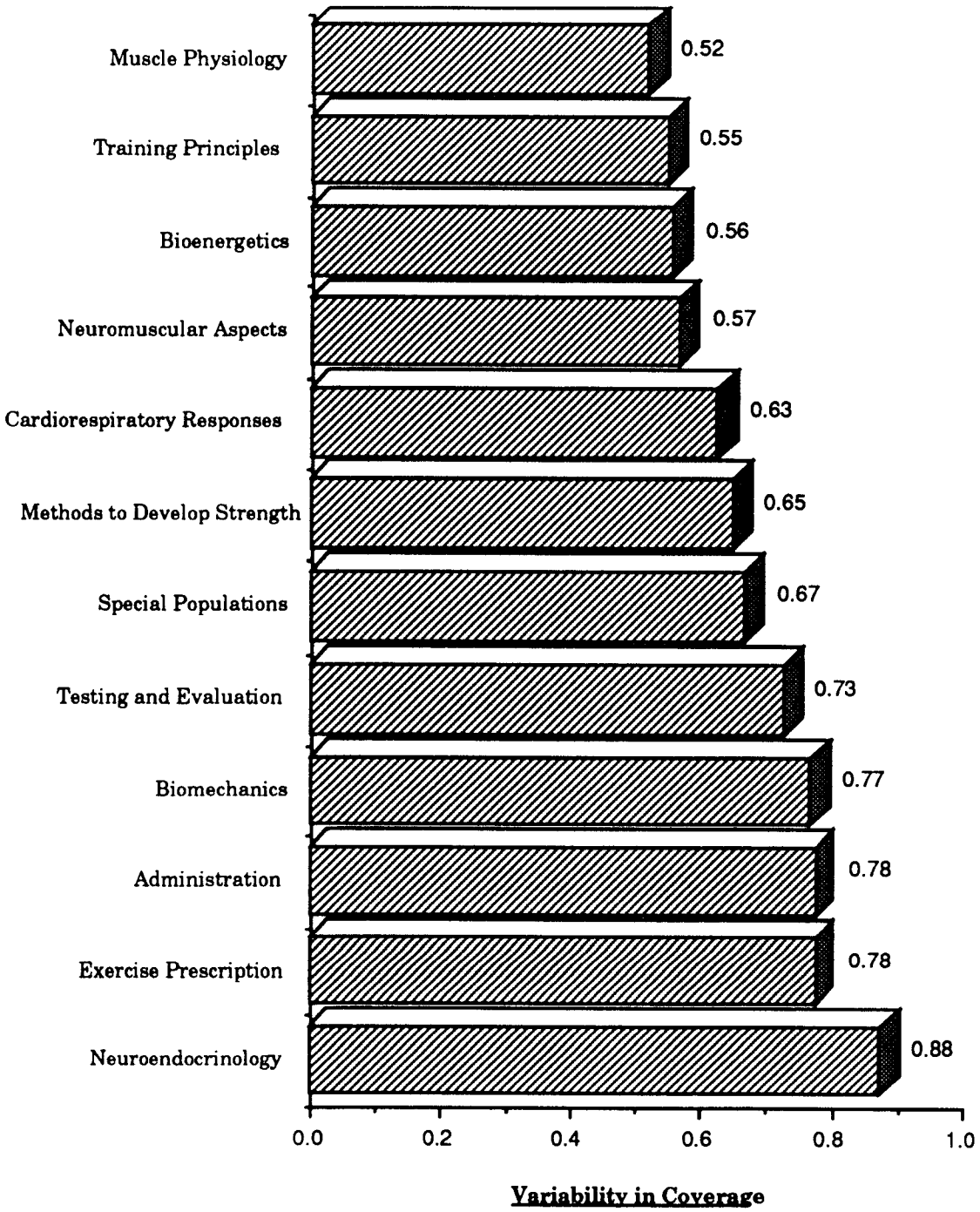

Figure 2. Categories ranked by variability in level of coverage

The three categories with the most consistently low level of coverage were Administration/Organizational Concerns, Special Populations, and Methods Used to Develop Strength.

Muscle Physiology

The content area receiving the greatest coverage in this category was Dynamics of Contraction (1-3). This content area also had the least variability in level of coverage. Because Dynamics of Contraction had the greatest coverage with the least variability, it can be said that this content area had the most consistently high coverage in this category. Conversely, Biochemical Adaptations to Strength Endurance Training (1-7) can be said to have the most consistently low coverage in the category of Muscle Physiology (Table 1).

Neuromuscular Aspects of Resistance Exercise

The content area of Neuromuscular Anatomy and Physiology (2-1) had the most consistently high coverage for this category. Neuromuscular Inhibition (2-4) received the most consistently low coverage (Table 2).

Table 1. Percent response, mean, median and standard deviation for content areas in Muscle Physiology.

Muscle Physiology	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
1-1 Muscle Structure		9.5	38.1	52.4	2.429	3.000	.665
1-2 Attachment/Arrangement of Fibers	1.6	11.1	44.4	42.9	2.286	2.000	.728
1-3 Dynamics of Contraction		4.8	31.7	63.5	2.587	3.000	.586
1-4 Muscle Fiber Type		11.1	38.1	50.8	2.397	3.000	.685
1-5 Muscle Adaptation to Resistance Exercise	1.6	3.2	34.9	60.3	2.540	3.000	.643
1-6 Biochemical Adaptations of Muscle to Strength Training	3.2	19.0	49.2	28.6	2.032	2.000	.782
1-7 Biochemical Adaptations to Strength Endurance Training	3.2	23.8	46.0	27.0	1.968	2.000	.803

Table 2. Percent response, mean, median and standard deviation for content areas in Neuromuscular Aspects.

Neuromuscular Aspects	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
2-1 Neuromuscular Anatomy and Physiology	1.6	7.9	52.4	38.1	2.270	2.00	.677
2-2 Motor Unit Recruitment Patterns		12.7	49.2	38.1	2.254	2.00	.671
2-3 Neuromuscular Adaptation to Resistance Exercise	1.6	25.4	54.0	19.0	1.905	2.00	.712
2-4 Neuromuscular Inhibition	4.8	33.3	44.4	17.5	1.746	2.00	.803
2-5 Myotatic Stretch Reflex	1.6	25.4	46.0	27.0	1.984	2.00	.772

Neuroendocrinology Relative to Resistance Exercise

Hormonal Response/Regulation (3-1), Hormonal Control of Energy Metabolism (3-2), and Role of Catecholamines (3-3) all received coverage that was "little to moderate." The variability in coverage was high for all three content items. Overall, Hormonal Control of Energy Metabolism had the most consistently high level of coverage for this category, while Hormonal Response/Regulation had the most consistently low coverage (Table 3).

Cardiovascular Response Relative to Resistance Exercise

The content area Effect of Resistance Exercise on Blood Pressure (4-2) had the most consistently high level of coverage, and Effect on Peripheral Vascular System (4-4) had the most consistently low coverage (Table 4).

Biomechanics

In this category, there were no great differences either in level of coverage or variability of coverage. The level of coverage was "moderate to extensive" with a variability of coverage that was moderate, .78 (Table 5).

Table 3. Percent response, mean, median and standard deviation for content areas in Neuroendocrinology.

Neuroendocrinology	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
3-1 Hormonal Response/Regulation	12.7	33.3	38.1	15.9	1.571	2.00	.911
3-2 Hormonal Control of Energy Metabolism	11.1	31.7	39.7	17.5	1.635	2.00	.903
3-3 Role of Catecholamines	12.7	36.5	31.7	19.0	1.571	2.00	.946

Table 4. Percent response, mean, median and standard deviation for content areas in Cardiovascular Response.

Cardiovascular Response	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
4-1 Effect of Resistance Exercise on the Heart	1.6	14.3	54.0	30.2	2.127	2.00	.707
4-2 Effect of Resistance Exercise on Blood Pressure		12.7	60.3	27.0	2.143	2.00	.618
4-3 Effect of Resistance Exercise on Serum Lipid Profiles	6.3	36.5	38.1	19.0	1.698	2.00	.854
4-4 Effect on the Peripheral Vascular System	1.6	34.9	46.0	17.5	1.794	2.00	.744

Table 5. Percent response, mean, median and standard deviation for content areas in Biomechanics.

Biomechanics	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
5-1 Movement Terminology	3.2	7.9	17.5	71.4	2.571	3.00	.777
5-2 Body Mechanics	3.2	7.9	22.2	66.7	2.524	3.00	.780

Bioenergetics Relative to Resistance Exercise

The content areas of Lactic Acid Metabolism (6-4) and Carbohydrate Metabolism (6-5) received the most consistently high coverage, with Nutritional Alternatives to Anabolic Steroids (6-8) receiving the most consistently low coverage within this category (Table 6).

Table 6. Percent response, mean, median and standard deviation for content areas in Bioenergetics.

Bioenergetics	Percent of Response				$\bar{X}$	M	SD
	None 0	Little 1	Moderate 2	Extensive 3			
6-1 Biological Energy Systems	1.6	14.3	31.7	52.4	2.349	3.00	.786
6-2 Metabolic Costs of Resistance Exercise	1.6	15.9	30.2	52.4	2.333	3.00	.762
6-3 Glycogen Utilization	1.6	12.7	36.5	49.2	2.333	2.00	.762
6-4 Lactic Acid Metabolism	1.6	7.9	38.1	52.4	2.413	3.00	.710
6-5 Carbohydrate Metabolism	1.6	7.9	41.3	49.2	2.381	2.00	.705
6-6 Amino Acid & Protein Metabolism/Needs	1.6	17.5	46.0	34.9	2.143	2.00	.759
6-7 Lipid Metabolism	3.2	19.0	46.0	31.7	2.063	2.00	.801
6-8 Nutritional Alternatives to Anabolic Steroids/ Growth Hormone	7.9	41.3	39.7	11.1	1.540	2.00	.800
6-9 Weight Gain	1.6	28.6	52.4	17.5	1.857	2.00	.715
6-10 Weight Loss	1.6	19.0	54.0	25.4	2.032	2.00	.718
6-11 Supplements	9.5	34.9	34.9	20.6	1.667	2.00	.916
6-12 Effects of dieting	6.3	20.6	52.4	20.6	1.873	2.00	.813

Training Principles/Theory and the Application to Resistance Exercise

The content areas in this category were found to have the greatest range in mean coverage and variability of all 12 categories (Table 7) . Mean coverage of the content areas ranged from 1.5 to 2.6. Variability ranged from .64 to .99. The content area that received the greatest coverage was Modes of Strength Training (7-4) with moderate variability in the level of coverage. Cross Training Theory (7-16) and Restoration Concepts (7-24) received the least coverage, but Cross Training had moderate variability in coverage while Restoration Concepts had a high degree of variability in the coverage. It may be concluded from the data that the content area of Modes of Strength Training had the most consistently high level of coverage and Cross Training Theory had the most consistently low level of coverage.

Methods Used to Develop Strength and Its Components/ Exercise Techniques

The Core Exercises (8-1) content area had the most consistently high coverage for this category. Olympic Lifts (8-3) had the lowest level of coverage, but a high level of variability. As a result, Functional Isometrics (8-5) had the most consistently low level of coverage. More than half (55%) of the content areas in this category had a median of 1.00, indicating that the coverage of these content areas is among the lowest of the 91 content areas (Table 8).

Table 7. Percent response, mean, median and standard deviation for content areas in Training Principles/Theory.

Training Principles/Theory	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
7-1 Anaerobic Capacity		14.3	30.2	55.6	2.413	3.00	.733
7-2 Aerobic Capacity		11.1	25.4	63.5	2.524	3.00	.692
7-3 Overload	4.8	6.3	33.3	55.6	2.397	3.00	.814
7-4 Modes of Strength Training	3.2	4.8	22.2	69.8	2.587	3.00	.733
7-5 Factors Affecting Strength	1.6	7.9	33.3	57.1	2.460	3.00	.714
7-6 Training Methods for Strength	3.2	11.1	33.3	52.4	2.349	3.00	.806
7-7 Factors Affecting Power	3.2	9.5	41.3	46.0	2.302	2.00	.775
7-8 Training Methods for Power	4.8	14.3	42.9	38.1	2.143	2.00	.840
7-9 Application of the Force-Velocity Curve in Training	4.8	20.6	34.9	39.7	2.095	2.00	.893
7-10 Athletic Speed Development	4.8	25.4	41.3	28.6	1.937	2.00	.859
7-11 Factors Affecting Strength Endurance	1.6	15.9	42.9	39.7	2.206	2.00	.765
7-12 Training Methods for Strength Endurance	4.8	17.5	44.4	33.3	2.063	2.00	.840
7-13 Factors Affecting Flexibility		15.9	52.4	31.7	2.159	2.00	.677
7-14 Training Methods for Flexibility	1.6	19.0	58.7	20.6	1.984	2.00	.684
7-15 Transfer of Training -Physiological Variables	1.6	23.8	61.9	12.7	1.857	2.00	.644
7-16 Cross Training Theory	4.8	44.4	46.0	4.8	1.508	2.00	.669
7-17 Specific Adaptation to Imposed Demands (S.A.I.D.)	4.8	19.0	47.6	28.6	2.000	2.00	.823
7-18 Specificity of Training		11.1	31.7	57.1	2.460	3.00	.692
7-19 General Adaptation Syndrome Theory (G.A.S.)	1.6	31.7	42.9	23.8	1.889	2.00	.785
7-20 Periodization	11.1	33.3	30.2	25.4	1.698	2.00	.978
7-21 Overtraining	6.3	23.8	44.4	25.4	1.889	2.00	.863
7-22 Variability of Training	7.9	27.0	42.9	22.2	1.794	2.00	.883
7-23 Rehabilitation Application	3.2	27.0	46.0	23.8	1.905	2.00	.797
7-24 Restoration Concepts	15.9	31.7	38.1	14.3	1.508	2.00	.931
7-25 Spotting	15.9	33.3	30.2	20.6	1.556	2.00	.996
7-26 Injury Prevention	9.5	22.2	34.9	33.3	1.921	2.00	.972

Table 8. Percent response, mean, median and standard deviation for content areas in Methods Used to Develop Strength/ Exercise Techniques.

Methods Used to Develop Strength/Exercise Tech.	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
8-1 Core Exercises	9.5	17.5	34.9	38.1	2.016	2.00	.975
8-2 Accessary Exercises	11.1	20.6	50.8	17.5	1.746	2.00	.879
8-3 Olympic Lifts	27.0	36.5	27.0	9.5	1.190	1.00	.948
8-4 Power Lifts	20.6	31.7	31.7	15.9	1.429	1.00	.995
8-5 Functional Isometrics	14.3	52.4	31.7	1.6	1.306	1.00	.750
8-6 Circuit Weight Training	9.5	25.4	50.8	14.3	1.698	2.00	.835
8-7 Interval Weight Training	14.3	36.5	34.9	14.3	1.492	1.00	.914
8-8 General Bodybuilding	9.5	34.9	49.2	6.3	1.524	2.00	.759
8-9 Plyometrics	14.3	42.9	30.2	12.7	1.413	1.00	.891

Exercise Prescription

The content areas of Frequency of Exercise (9-3) and Duration of Exercise (9-4) received the greatest coverage, but had a moderately high degree of variability. Recovery/Restoration (9-8) received low coverage with the greatest variability. Overall, Exercise Selection (9-5) had high coverage within the category and the lowest variability, and as such, reflected the most consistently high level of coverage. Exercise Speed (9-7) had the most consistently low level of coverage (Table 9).

Table 9. Percent response, mean, median and standard deviation for content areas in Exercise Prescription.

Exercise Prescription	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
9-1 Estimation of Workload	4.8	20.6	46.0	28.6	1.984	2.00	.833
9-2 Methods of Varying Intensity, Volume, and Load	4.8	17.5	39.7	38.1	2.111	2.00	.863
9-3 Frequency of Exercise	4.8	12.7	38.1	44.4	2.222	2.00	.851
9-4 Duration of Exercise	4.8	12.7	39.7	42.9	2.206	2.00	.845
9-5 Exercise Selection	4.8	11.1	44.4	39.7	2.190	2.00	.820
9-6 Exercise Order, Sets, Repetitions	7.9	11.1	42.9	38.1	2.111	2.00	.900
9-7 Exercise Speed	6.3	25.4	42.9	25.4	1.873	2.00	.871
9-8 Recovery/Restoration	9.5	19.0	39.7	31.7	1.937	2.00	.948

Testing and Evaluation

The variability in the level of coverage was high for all but one of the content areas in this category. Body Composition (10-6) had the most consistently high level of coverage and Power Production (10-4) the most consistently low level of coverage (Table 10).

Special Populations

Gender Similarities/Differences (11-1) and Prepubescent (11-2) had the most consistently high coverages of the content areas and Physically/ Mentally Disadvantaged (11-4) the most consistently low coverage (Table 11).

Table 10. Percent response, mean, median and standard deviation for content areas in Testing and Evaluation.

Testing and Evaluation	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
10-1 Anaerobic Capacity	9.5	12.7	39.7	38.1	2.063	2.00	.948
10-2 Muscular Strength	6.3	6.3	46.0	41.3	2.222	2.00	.832
10-3 Muscular Endurance	4.8	7.9	52.4	34.9	2.175	2.00	.773
10-4 Power Production	7.9	17.5	49.2	25.4	1.921	2.00	.867
10-5 Flexibility	6.3	15.9	41.3	36.5	2.079	2.00	.885
10-6 Body Composition	4.8	9.5	30.2	55.6	2.365	3.00	.848

Table 11. Percent response, mean, median and standard deviation for content areas in Special Populations.

Special Populations	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
11-1 Gender Similarities/Differences	6.3	27.0	47.6	19.0	1.794	2.00	.826
11-2 Prepubescent	4.8	42.9	41.3	11.1	1.587	2.00	.754
11-3 Elderly	7.9	46.0	34.9	11.1	1.492	1.00	.801
11-4 Physically/Mentally Disadvantaged	27.0	44.4	23.8	4.8	1.063	1.00	.840

Administration/Organizational Concerns

All the content areas in this category had a median of 1.00. This indicates that this category had the lowest coverage overall. Legal Issues (12-3) had a low level of coverage and the least variability in response. Therefore, Legal Issues had the most consistently low level of coverage. Equipment Selection had the most consistently high level of coverage (Table 12).

Table 12. Percent response, mean, median and standard deviation for content areas in Adminstration/Organizational Concerns.

Administration/ Organizational Concerns	Percent of Response						
	None 0	Little 1	Moderate 2	Extensive 3	$\bar{X}$	M	SD
12-1 Staffing/Supervision	22.2	36.5	36.5	4.8	1.238	1.00	.856
12-2 Facility Maintenance/Inspection	22.2	39.7	28.6	9.5	1.254	1.00	.915
12-3 Legal Issues Relative to Resistance Exercise	14.3	49.2	33.3	3.2	1.254	1.00	.740
12-4 Facilty Design	25.4	42.9	19.0	12.7	1.190	1.00	.965
12-5 Equipment Selection	20.6	33.3	36.5	9.5	1.349	1.00	.919

Section II

Section II recorded the undergraduate program options with an emphasis on resistance exercise. Of the 63 respondents, 7 listed undergraduate physical education program options with an emphasis on resistance exercise. A list of these program option titles appears in Appendix G. Of the seven reported program options, only one contained

direct reference to the area of resistance exercise. Four respondents included resistance exercise as a subdivision of exercise science.

Section III

Section III encouraged respondents to list any additional areas that they believed should be included and to make any supplemental comments they deemed important regarding the topics covered in the questionnaire. This served to further appraise the content validity of the instrument. Only 3 of the 63 respondents indicated additional content areas. Suggested were Motor Learning and Control, Psychological Aspects, and Communication Skills/Counseling. Appendix H contains a list of additional comments from respondents.

CHAPTER 5

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Summary

The central objective of this study was to determine whether differences exist in the level of coverage of resistance exercise in select four-year college and university undergraduate physical education programs. The study also explored whether differences exist between content areas suggested for training resistance exercise specialists and the curriculum being offered. A final dimension of the study identified existing program options with an emphasis on resistance exercise. The goal was to identify information that might be applied by college and university-level curriculum specialists in the development of resistance exercise related courses. The survey instrument (Appendix F) was developed by integrating components identified in the NSCA Role Delineation Study and review of the literature related to resistance exercise. A panel of specialists was employed to expand, modify, and validate the instrument (Appendix A). Revisions were made based on the feedback from the panel. Twelve categories and 91 content areas were identified. The research instrument was composed of three sections: I. Category and content area coverage; II. Program option; III. Additional areas and supplemental comments.

In Section I, content area items were scored to denote the level of coverage according to the following 4-point Likert scale: 0= None; 1= Little; 2= Moderate; 3= Extensive. Section II had respondents list program options with an emphasis in resistance exercise. Section III asked respondents to list additional content areas they believed should be included in curriculum related to resistance exercise, and for supplemental comments.

The study population comprised a total of 76 National Strength and Conditioning Association (NSCA) members who were listed under undergraduate physical education programs in the Physical Education Gold Book. Of the 76 members contacted, 63 (83%) completed and returned the questionnaire.

Returned instruments were assigned a code number, and the content areas of Section I were entered into a data base. Frequency distributions were computed to examine the data. Means, medians, and standard deviations were calculated to summarize the responses to each of the 91 content areas. The 12 categories were ranked by mean to examine central tendency and then ranked by standard deviation to examine variability across institutions.

The findings of the study showed that the three categories with the most consistently high coverage were Muscle Physiology, Biomechanics, and Testing and Evaluation. The three categories with the most consistently low level of coverage were Administration/Organizational

Concerns, Special Populations, and Methods Used to Develop Strength. The content areas with the most consistently high level of coverage were Dynamics of Contraction, Movement Terminology, Body Mechanics, Lactic Acid Metabolism, and Modes of Strength Training. The content areas receiving the most consistently low level of coverage were Legal Issues, and Functional Isometrics.

Conclusions

On the basis on the findings of this study, the following conclusions may be drawn:

1. The level of coverage differs significantly among four-year college and university undergraduate physical education programs.

2. While overall responses indicated coverage in all content areas, some institutions did not offer curriculum that covered all the suggested content areas.

3. Few undergraduate programs options exist with an emphasis in resistance exercise.

4. Categories and content areas suggested for resistance exercise curriculum specialists have been determined as a result of the study.

Implications

One of the purposes of this study was to determine if differences exist between content suggested for training resistance exercise specialists and the curriculum being offered. The categories and content areas of the questionnaire were based on suggested content for training resistance exercise specialists. While all of the content areas received coverage, the majority (90%) had at least one "None" response indicating that an institution does not offer curriculum for that content area. Fifteen content areas had seven or more "none" responses, with the content areas of Physically/Mentally Disadvantaged (11-4) and Olympic Lifts (8-3) reporting deficiencies as high as 27 percent (Figure 3).

The results of this study demonstrate that salient differences also exist in the level or extent of coverage of resistance exercise curriculum. In weighing the probable impact of low coverage of categories on the quality of resistance exercise curriculum it is meaningful to look at the significance given these areas by professionals currently working as strength and conditioning specialists. The NSCA Role Delineation Study formulated performance domains and identified tasks within each domain considered essential for proper performance. Each task was rated on its level of importance and criticality. Importance was defined as "the relative value" of each task and criticality was defined as asking "What harm will occur if I cannot perform this task adequately?"

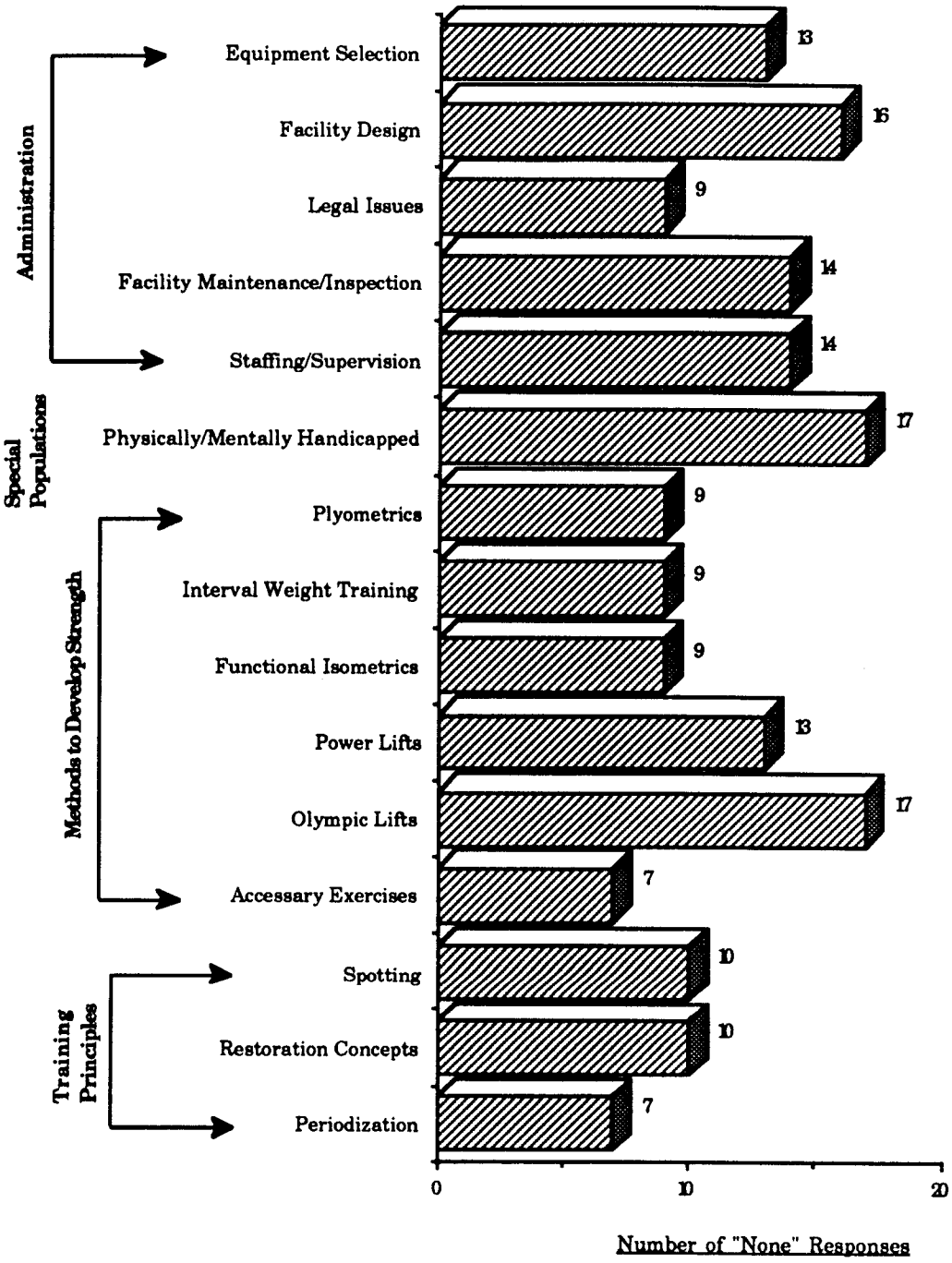

Figure 3. Content areas with seven or more "None" responses.

Importance was rated on the following scale: "1- Not Important, 2- Somewhat Important, 3- Important, 4- Very Important, 5- Extremely Important." Criticality was rated on a similar scale; "1- No Harm, 2- Minimal Harm, 3- Moderate Harm, 4- A Lot of Harm, 5- Extreme Harm" (NSCA, 1988).

Examining the content areas within the category of Administration/ Organizational Concerns it is noted that all have a median of 1.00, denoting low coverage. The individual content areas of Staffing/Supervision, Facility Maintenance, and Facility Design were rated by the NSCA Role Delineation Study as being "important to very important" and were rated in terms of criticality as having the potential for "a lot of harm to extreme harm" if the task is not performed adequately. The legal responsibilities of the strength and conditioning specialist have been well documented (Halling, 1990), yet the content area of Legal Issues has, overall, the most consistently low coverage of all 91 content areas. Recognizing the change in public reaction to injury and the rapidly growing societal preoccupation with litigation, the failure to educate students as to their legal obligations or duties may place students in legal jeopardy, and colleges and universities in the courtroom defending their instruction.

The category of Special Populations was rated by the NSCA Role Delineation Study as being "very important" and having the potential for "a lot of harm" if considerations in prescribing exercise were not performed adequately, yet overall this category was second to Administration/

Organizational Concerns in having a consistently low level of coverage. The content area of Physically/Mentally Disadvantaged had the highest percentage of none responses and the most consistently low level of coverage in this category.

Federal legislation (PL 94-142) in this country mandates that physically or mentally disadvantaged individuals receive equal access to programs and facilities funded by federal monies. In the past this has meant providing alternate facilities and opportunities for the handicapped. Recently, however, various organizations concerned with the rights of the handicapped are involved in bringing about legislation to provide for mainstreaming of the handicapped in both private and public domains. This mainstreaming will bring greater numbers of the physically and mentally handicapped who are seeking participation in fitness activities in contact with exercise specialists. The Special Olympics includes powerlifting in their international competitions and strength and conditioning for the multitude of Special Olympic sport activities has been encouraged. The exclusion of curriculum that addresses the unique characteristics of this population and their possible involvement in resistance exercise, indirectly does this segment of the population a great disservice. This study demonstrates that little is being done to prepare students to instruct and assist this segment of the population in becoming more involved in resistance exercise.

While Physically/Mentally Disadvantaged received the lowest level of coverage in this category, the content areas of Gender Similarities/ Differences (11-1) and the Elderly (11-3) also had relatively low coverage. The coverage of Gender Similarities/Differences holds specific importance, recognizing the crippling effects of osteoporosis, a disease recognized as a growing health concern for older women and men in Western society. Resistance exercise, often in the past considered a male dominated activity, may hold even greater importance for women. Peak bone density for women occurs at roughly 18 years of age and then decreases at approximately 0.7% per year until menopause, at which time it decreases rapidly for about the next 10 years. Recent research into osteoporosis, its causes, and remediating factors indicates that the magnitude of the loading during exercise is more important than the number of cycles performed. This indicates that resistance exercise is ideally suited for women as a means to increase bone mineral density during their pre-menopause years, as well as decreasing the magnitude of loss during their post-menopause years (Snow-Harter and Marcus, 1991).

The level of coverage for the content area of the Elderly was second lowest in the category of Special Populations and should be cause for real concern to those promoting the health related aspects of exercise. No element in our society is growing a such an accelerated pace as the age group 60 years and older. The number of older persons has increased 21% since 1980, while the age groups under 65 have increased only 8%.

Older persons constitute 13% of the population in the United States, but account for 63% of the benefits paid from Medicare and Medicaid for health care (American Association of Retired Persons, 1990). It has been estimated that roughly 50% of the ailments afflicting the elderly can be attributed to inactivity (hypokinesia). Frontera, Meredith, O'Reilly, Knuttgen, and Evans (1988) have noted that after age 74, 28% of men and 66% of women are unable to lift 10 pounds, approximately the weight of an average bag of groceries. The loss of functional strength affects the ability of older person to carry out activities of daily living, and is a major reason for institutionalization of many older persons. Loss of functional strength is also a contributing factor in falling accidents. Fleming, Wilson, and Pendergast (1991) demonstrated that lower body power was a predictor of those persons most likely to fall. Statistics show that deaths from falls exceed deaths from other accidents, and are the sixth leading cause of death among older persons. Brown, McCartney and Sale (1990) conducted research that showed that the elderly are not only capable of increasing their strength through neural facilitation, but through increases in muscle fiber hypertrophy, the same changes seen in younger subjects. The potential for decreasing health care costs, decreasing accidental deaths due to falls , and increasing the functional independence and quality of life for the older population through involvement in resistance exercise is great.

The category of Methods Used to Develop Strength had over 55% of the content areas with a median of 1.00, indicating multiple "None" responses.

The individual content areas in this category received the following high importance and criticality ratings; however, the level of coverage for this category seems to indicate less importance and criticality:

Plyometrics - "very important", "a lot of harm"

Flexibility - "very important", "a lot of harm"

Core Exercises - "extremely important", "extreme harm"

Accessary Exercises - "extremely important", "extreme harm"

Olympic Lifting - "extremely important", "extreme harm"

Power Lifting - "extremely important", "extreme harm"

(NSCA, 1988). The content area of Olympic Lifts had approximately one third of the respondents indicating no coverage. Yet, objective measurements have shown that Olympic lifters produce the greatest power output found in any human activity. The neuromuscular comparisons of these multiple joint lifts to the specific demands of athletic movements have shown the greatest transfer of training effect and involve over 50 percent of the body's muscle mass, thus epitomizing the concept of athletic power (Garhammer, 1981; Mastropaolo, 1975). Physical educators routinely measure power, yet the respondents in this study clearly demonstrate that limited instruction is received by our nation's undergraduate physical education students regarding the most significant power indicators known.

The disparity is considerable between the level of coverage in the afore mentioned categories and the recognized importance and criticality of these areas as identified by professionals in the field of resistance exercise.

Of the estimated 85 million people who exercise, 43,000 sustain weightlifting injuries annually (Fitness Risk Management, Inc., 1992). Students graduating as exercise specialists have a duty to provide a safe environment and an adequate level of supervision to ensure the appropriate standard of care for program participants (Halling, 1990). Overall, the 91 content areas received "moderate" coverage. Given the inherent risks and potential for harm associated with weight resistance exercise, the researcher questions whether or not "moderate" coverage of the content areas will adequately prepare graduates to provide a reasonable standard of care. Colleges and universities must address the above discrepancies and better prepare emerging specialists.

Currently, no common basis exists among four-year colleges and universities for establishing resistance exercise curriculum. The findings of this study demonstrate that the domains, tasks, and knowledges outlined in the NSCA Role Delineation Study and used to develop the categories and content areas for this research, need to be used in the development of a comprehensive list of competencies pertinent to the effective performance of a resistance exercise specialist. The identified competencies should then be used to modify existing exercise science curriculum to reflect adequate coverage for exercise specialists with regard to resistance exercise. The format suggested for reviewing curriculum relative to established competencies for the field specialist has been outlined by the National Athletic Trainers' Association (1983). An inclusive list of competencies in

resistance exercise will provide guidance and direction in the preparation of an option for resistance exercise specialists. Exercise scientists have long promoted muscular strength and muscular endurance strength as two of the basic components of fitness. It is now time for them to recognize their responsibilities in research and instruction of strength physiology and its practical applications. A model resistance exercise specialist option, derived from the categories and content areas used in this study, appears in Appendix I.

Recommendations

1. Further study needs to be conducted to determine the content and level of coverage for resistance exercise in all four-year undergraduate college and universities in the United States.

2. A longitudinal study of resistance exercise curriculum is needed to determine new or sustained patterns of resistance exercise curriculum coverage.

3. This study should be replicated, including demographics of respondents to determine if relationships exist between the level of coverage of content and specific characteristics (i.e., age, gender, and years of teaching experience).

4. Revisions in current curriculum need to be made to reflect comprehensive coverage of all categories and content areas in keeping with

the importance and criticality assigned to these areas by the NSCA Role Delineation Study.

5. Resistance exercise curriculum must reflect greater concern for the Mentally/Physically Disadvantaged and prepare students to work with, and increase involvement of this population in resistance exercise.

6. Greater utilization of resistance exercise activities throughout the life-span should be encouraged for all segments of society (children, women, elderly, and the disadvantaged) under well established guidelines.

7. Research should be conducted to determine the competencies necessary for effective functioning as a resistance exercise specialist to be utilized in development of resistance exercise curriculum.

8. The researcher proposes that a medical or health related organization (NSCA, ACSM) should establish accreditation procedures to evaluate the exercise science curriculum (coursework, clinical experience) with specific reference to the contributions made to the student's development of competencies in the area of resistance exercise. A common basis must exist for evaluation of resistance exercise curriculum.

9. Medical, educational, and health related research organizations need to accept their responsibilities for investigation, instruction, and promotion of strength related exercise activities. Exercise scientists must close the breach between strength research and its practical application. Guidelines for functional strength development for all segments of society

must be established and continually updated, acknowledging educational and technological advances.

10. Colleges and universities must prepare emerging exercise specialists with an understanding of their legal duties and obligations. Participants involved in programs utilizing resistance exercise must have a safe environment and be assured a reasonable standard of care.

11. The researcher suggests that the term resistance exercise be superseded with the more positive and descriptive phrase of strength fitness training.

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APPENDICES

APPENDIX A
Panel of Specialists

Athletic Strength & Conditioning

Kevin Fulton, C.S.C.S.
Strength and Conditioning Coordinator
University of Massachusetts
Department of Athletics
Amherst, Massachusetts 01003

Pete Martinelli, M.S.
Strength and Conditioning Coordinator
University of Oklahoma
Department of Athletics
Norman, Oklahoma 73019

Commercial

Michael Jelich, M.S.
Owner/Executive Director Nubody Fitness
Milwaukee, Wisconsin 53201

Kent Cramer, C.S.C.S.
Program Director
Portland Metro YMCA
Portland, Oregon 97201

Academic

Tom Baechle, Ed.D., C.S.C.S.
Department Chair
Physical Education and Exercise Science
Creighton University
Omaha, Nebraska 68178

Richard Borden, Ph.D., P.T., A.T.C., C.S.C.S.
Dean, School of Health Professions
Northern Arizona University
Flagstaff, Arizona 86011

APPENDIX B
Cover Letter

February 27, 1992

Respondent name
University/College
Department of Physical Education
Street Address
City, State. Zip code

Dear Respondent,
Today the popularity of resistance training (i.e., weight or strength training) is well established as it is routinely used in programs of health related exercise, and in recreational, occupational, and sports training. Professional certifications have emerged which focus strongly on resistance exercise and its components, and while pertinent content areas are being identified there seems to be a gap as to what preparatory coursework is being offered to undergraduate students across the country who have chosen to pursue careers related to this area of study.

You as a select professional with interest in this speciality area may assist in identifying and clarifying the content covered within your institutions curriculum. In order that the result of this study will truly represent the undergraduate curriculum offerings related to resistance exercise it is crucial that each questionnaire be completed and returned.

You and your institution may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off of the mailing list when your questionnaire is returned. Your name or that of your institution will never be placed on the questionnaire.

You may receive a summary of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it. Please do not put this information on the questionnaire itself.

The information you provide may assist fellow professionals in the development of curriculum and the student practitioner for self- assessment and appraisal of their knowledge base related to resistance exercise and its components. Valid results are dependent upon your completion and return of the enclosed questionnaire. It is vitally important that the questionnaire be completed and returned before March 5, 1992. I would be happy to answer any questions you may have. Please call (503) 737-6795.

Thank you for your assistance.

Sincerely,

Daye H. Halling
Project Director
Oregon State University
Department of Exercise and Sport Science
Langton Hall 121-E
Corvallis, Oregon 97331-3302
(503) 737-6795

Dr. John Patrick O'Shea, Ed.D.
Program Coordinator

APPENDIX C
Follow-up Postcard

March 5, 1992

Name
Institution
Dept.
City, State, Zip

Dear Participant,

Last week you were mailed a questionnaire seeking information about the resistance exercise curriculum at your institution.

If you have completed and returned the questionnaire to us please accept our sincere thanks. If you have not, please do so today. Because the information requested is from such a select group of specialists it is extremely important that we receive your response.

If by some chance you did not receive the questionnaire, or it got misplaced, please call me immediately (503) 752-4638 and I will get another one in the mail to you today.

Sincerely,

Daye H. Halling
Project Director
Oregon State University
Department of Exercise and Sport Science
Langton Hall 121-E
Corvallis, Oregon 97331-3302
(503) 737-6795

APPENDIX D
First Letter Follow-up

March 19, 1992

Name
Institution
Dept.
City, State, Zip

Dear Participant,

About three weeks ago I wrote to you seeking information about the resistance exercise curriculum at your institution. As of today we have not yet received your completed questionnaire. We have undertaken this study to identify the preparatory coursework relative to resistance exercise that is being taught at select four year undergraduate Physical Education programs in order to assist others in the development of curriculum.

I am writing to you again because of the significance each questionnaire has to the usefulness of this study. You are part of a select group of specialists and in order that the results of this study will truly represent the resistance exercise curriculum currently being covered, it is crucial that each questionnaire be completed and returned.

In the event that your questionnaire has been misplaced, a replacement is enclosed.

Your cooperation is greatly appreciated.

Sincerely,

Daye H. Halling
Project Director
Oregon State University
Department of Exercise and Sport Science
Langton Hall 121-E
Corvallis, Oregon 97331-3302
(503) 737-6795

APPENDIX E
Second Letter Follow-up

March 31, 1992

Name
Institution
Dept.
City, State, Zip

Dear Participant,

I am writing to you about our study seeking information about the resistance exercise curriculum at your institution. We have not yet received your completed questionnaire.

The large number of questionnaires returned is very encouraging. But, whether we will be able to accurately identify the curriculum that is being taught depends upon you and others who have not yet responded. Past experience suggests that those of you who have not yet sent in your questionnaire may have quite different program offerings.

The popularity and involvement of participants in resistance exercise has been recognized, and it is our hope that the results of this research will assist the professional in the development of curriculum and the student practitioner in competency development.

I am writing to you again because of the significance each questionnaire has to the usefulness of this study. You are part of a select group of specialists and in order that the results of this study will truly represent the resistance exercise curriculum currently being covered, it is crucial that each questionnaire be completed and returned. In case our other correspondence did not reach you, a replacement questionnaire is enclosed. May I urge you to complete and return it as quickly as possible.

I would be happy to send you a summary of the results if you would like one., Simply put your name, address, and "copy of results requested" on the back of the return envelope. We expect to have then ready to send early next Fall.

Your contribution to the success of this study is greatly appreciated.

Sincerely,

Daye H. Halling
Project Director
Oregon State University
Department of Exercise and Sport Science
Langton Hall 121-E
Corvallis, Oregon 97331-3302
(503) 737-6795

APPENDIX F
Survey Questionnaire

Analysis of Resistance Exercise Curriculum in Select Four Year Undergraduate Physical Education Programs

I. Resistance Exercise Curriculum: Each statement in the table below reflects a content area of instruction. Please indicate what degree of coverage the following content area's have in your undergraduate curriculum. Please rate each content area by circling one number on the following scale:

	Level of Coverage			
	None	Little	Moderate	Extensive
Muscle Physiology				
Muscle Structure	0	1	2	3
Dynamics of Contraction	0	1	2	3
Muscle Fiber Type				
Enzymatic Profile of Fast and Slow Twitch Fibers	0	1	2	3
Muscle Adaptation to Resistance Exercise (e.g., Hypertrophy, Hyperplasia, Atrophy)	0	1	2	3
Biochemical Adaptations of Muscle to Strength Training	0	1	2	3
Biochemical Adaptations of Muscle to Strength Endurance Training	0	1	2	3
Neuromuscular Aspects Relative to Resistance Exercise				
Neuromuscular Anatomy and Physiology	0	1	2	3
Motor Unit Recruitment Patterns	0	1	2	3
Neuromuscular Adaptation to Resistance Exercise	0	1	2	3
Neuromuscular Inhibition	0	1	2	3
Neuroendocrinology Relative to Resistance Exercise				
Hormonal Response/Regulation (Insulin, Growth Hormone, Anabolic Hormones, etc.,)	0	1	2	3
Hormonal Control of Energy Metabolism	0	1	2	3
Role of Catecholamines	0	1	2	3

(Please turn the page)

	Level of Coverage			
	None	Little	Moderate	Extensive
Cardiovascular Response Relative to Resistance Exercise				
Effect of Resistance Exercise on the Heart (e.g., Size, Heart Rate, etc.)	0	1	2	3
Effect of Resistance Exercise on Blood Pressure	0	1	2	3
Effect of Resistance Exercise on Serum Lipid Profiles	0	1	2	3
Biomechanics of Resistance Exercise				
Movement Terminology	0	1	2	3
Muscle Dynamics	0	1	2	3
Attachment/Arrangement of Fibers	0	1	2	3
Body Mechanics (e.g., Lever Systems, Agonist/Antagonist, Acceleration/Deceleration)	0	1	2	3
Myotatic Stretch Reflex/Plyometrics	0	1	2	3
Bioenergetics Relative to Resistance Exercise				
Biological Energy Systems Relative to Resistance Exercise	0	1	2	3
Metabolic Costs of Resistance Exercise Muscle ATP, CP, and LA at Submaximal/Maximal Exercise (Max VO_2, O_2 Debt)	0	1	2	3
Glycogen Utilization (Influence of Intensity and Duration of Exercise on Supply and Use)	0	1	2	3
Lactic Acid Metabolism	0	1	2	3
Carbohydrate Metabolism	0	1	2	3
Amino Acid & Protein Metabolism/Needs	0	1	2	3
Lipid Metabolism Metabolism of Free Fatty Acids/Ketone Bodies in Skeletal Muscle (Influence of Intensity and Duration of Exercise on Supply and Use)	0	1	2	3
Nutritional Alternatives to Anabolic Steroids/Growth Hormone	0	1	2	3
Weight Gain	0	1	2	3

	Level of Coverage			
	None	Little	Moderate	Extensive
Bioenergetics Relative to Resistance Exercise (continued)				
Weight Loss	0	1	2	3
Supplements	0	1	2	3
Effects of dieting	0	1	2	3
Training Principles/Theory and the Application to Resistance Exercise				
Anaerobic Capacity	0	1	2	3
Aerobic Capacity	0	1	2	3
Overload	0	1	2	3
Modes of Strength Training (e.g., Isometric, Isotonic, Isokinetic, etc.)	0	1	2	3
Strength				
Factors Affecting Strength	0	1	2	3
Training Methods	0	1	2	3
Power				
Factors Affecting Power	0	1	2	3
Training method	0	1	2	3
Application of the Force-Velocity Curve in Training	0	1	2	3
Athletic Speed Development	0	1	2	3
Strength Endurance				
Factors affecting Strength Endurance	0	1	2	3
Training Methods	0	1	2	3
Flexibility Training				
Factors Affecting Flexibility	0	1	2	3
Training Methods	0	1	2	3

(Please turn the page)

	Level of Coverage			
	None	Little	Moderate	Extensive
Training Principles/Theory and the Application to Resistance Exercise (continued)				
Transfer of Training				
Physiological Variables	0	1	2	3
Cross- Training Theory and Application	0	1	2	3
Specific Adaptation to Imposed Demands (S.A.I.D.)	0	1	2	3
Specificity of Training	0	1	2	3
General Adaptation Syndrome Theory (G.A.S.)	0	1	2	3
Periodization				
The Annual Plan (Training Phases and their Characteristics; Physiological Criteria, and Training Parameters Utilized)	0	1	2	3
Overtraining	0	1	2	3
Variability of Training	0	1	2	3
Rehabilitation Application	0	1	2	3
Methods Used to Develop Strength and its Components/Exercise Techniques				
Core Exercises	0	1	2	3
Accessary Exercises	0	1	2	3
Olympic Lifts	0	1	2	3
Power Lifts	0	1	2	3
Functional Isometrics	0	1	2	3
Circuit Weight Training	0	1	2	3
Interval Weight Training	0	1	2	3
General Bodybuilding	0	1	2	3
Spotting	0	1	2	3

	Level of Coverage			
	None	Little	Moderate	Extensive
Exercise Prescription (Acute/Chronic Variables)				
Estimation of Workload	0	1	2	3
Methods of Varying Intensity, Volume, and Load	0	1	2	3
Frequency of Exercise	0	1	2	3
Duration of Exercise	0	1	2	3
Exercise Selection	0	1	2	3
Exercise Order, Sets, Repetitions	0	1	2	3
Exercise Speed	0	1	2	3
Recovery/Restoration	0	1	2	3
Testing and Evaluation				
Anaerobic Capacity	0	1	2	3
Muscular Strength	0	1	2	3
Muscular Endurance	0	1	2	3
Power Production	0	1	2	3
Flexibility	0	1	2	3
Body Composition	0	1	2	3
Special Populations (Training Considerations)				
Gender Similarities/Differences	0	1	2	3
Prepubescent	0	1	2	3
Elderly	0	1	2	3
Physically/Mentally Disadvantaged	0	1	2	3

(Please turn the page)

	Level of Coverage			
	None	Little	Moderate	Extensive
Administration / Organizational Concerns				
Staffing/Supervision	0	1	2	3
Facility Maintenance/Inspection	0	1	2	3
Relationship of the Law Relative to Resistance Exercise	0	1	2	3
Facility Design	0	1	2	3
Equipment Selection	0	1	2	3

II. Do you have an undergraduate program option with its emphasis on resistive exercise?

(Circle one response)

1. YES **2. NO**

If YES, please list the program option title:_____

III. The preceding questions asked you to indicate what degree of coverage your undergraduate curriculum demonstrates in the content areas listed. Are there additional areas that you believe should be included ? Do you have any comments you wish to make regarding the topics covered in the questionnaire ? (Please use the space below and the back of this sheet , if necessary).

Thank you for your assistance.

Please mail the survey in the enclosed envelope or return to:

Daye Halling, Project Director
Oregon State University
Department of Exercise & Sport Science
Langton Hall 121-E
Corvallis, Oregon 97331-3302

APPENDIX G
Programs Option Titles with an Emphasis on Resistance Exercise

Do you have an undergraduate program option with its emphasis on resistive exercise? If yes, please list the program option title.

1. Clinical Aspects of Exercise

2. Athletic Training/Strength and Conditioning

3. Exercise Science-Fitness Management

4. Exercise Physiology-Specialist Certification

5. No title given

6. Exercise Science

7. No title given

APPENDIX H
Comments from Section III of Survey Questionnaire

The preceding questions asked you to indicate what degree of coverage your undergraduate curriculum demonstrates in the content areas listed. Are there any additional areas that you believe should be included? Do you have any comments you wish to make regarding the topics covered in the questionnaire?

"Complete, good. Psychological aspect. Motor learning."

"We cover this information through exercise physiology and strength training courses. Students interested in this area take a Corporate/Community Fitness degree, where aspects of training are covered."

"What is the difference between S.A.I.D. and specificity of training? What is interval weight training? All weight training is interval."

"Our response is the combination of three courses in our undergraduate core curriculum - Physiology of Exercise, Motor Learning & Development, and Biomechanics. Students may get additional information than that indicated on this survey if they take additional courses such as: Weight Training and Exercise Testing and Prescription. The three courses included for this survey are required for all undergraduate majors."

"Difficult to evaluate content of all undergraduate courses (e.g. personal fitness may cover same areas not considered in major exercise physiology courses). Response based primarily on undergraduate exercise physiology. What is the biochemical adaptation of muscle to strength endurance training?"

"We have undergraduate programs for physical education teachers and one for wellness/exercise specialists. The Wellness /Exercise Specialist majors take additional courses in Advanced Exercise Physiology and experience more extensive study in some area covered in the questionnaire."

"Unfortunately, the present administration is not at all interested in the initiation of an undergraduate program related to resistance training. I pushed very hard last year to initiate a mater's degree program in Applied Musculoskeletal studies, but was unsuccessful in getting it past the Vice-President for Academic Affairs. Consequently, I am looking for a more receptive environment."

"The only shortcoming in the curriculum of The _____ University, is that there is no instruction involving powerlifting, olympic lifting, and bodybuilding techniques, and how they might be incorporated into special sport exercise prescriptions."

"Biomechanics of resistance exercise is taught only in kinesiology."

"Plyometrics taught is more theory than technique."

"All responses refer to overall undergraduate curriculum not any particular class. We don't know of any nutritional alternatives to anabolic steroids."

"No undergraduate major in PE or Exercise Science. We offer elective courses in Exercise Physiology for Kinesiology major only."

"This area is addressed in a non teaching degree undergraduate curriculum in Fitness/Wellness Management."

"Our experiences have shown a need for a class (or two) regarding people skills. We require one counseling course."

"Psychological aspects of training."

"We do not have an undergraduate concentration in "Resistance Exercise". There is a team of exercise physiologists who teach the undergraduate class and they completed the questionnaire. We do, however, have a graduate course in the area of Sports Conditioning and have graduated a number (small) of M.S. degree students with expertise in the area. They have gone on to become strength and conditioning coaches at major institutions or with a professional team."

"Many areas of the questionnaire are covered in courses such as: Exercise Physiology; Anatomical Kinesiology; Mechanical Kinesiology; Test & Measurements; Exercise, Diet & Weight Control; etc. and not specifically in a resistance training course or emphasis."

"Our 'Fitness' tract emphasizes aerobic exercise but does cover resistance training. Appropriate choices of optional/elective classes can balance this with anaerobic exercises. The responses given assume two things on the part of the interested student:

1) He/she will chose the best elective classes for obtaining knowledge in the area of resistance exercise, strength , etc. For example, my responses assume the student elects to take Advanced Strength & Conditioning and Applied Biomechanics (these are not required core courses).

2) In the core courses the student chooses the 'best' instructor relative to instructor's areas of interest and reputation. For example, in Exercise Physiology and Kinesiology students may have the choice of two or three instructors depending on spring versus fall semester. The coverage of material can be very different even though in theory it is very similar."

"It is my contention that more emphasis needs to be placed on the biomechanics of rehabilitation as it pertains to resistive training."

APPENDIX I
Model for Strength and Conditioning Specialist Program Option

_____University
Department of Exercise and Sports Science

I. **Baccalaureate Core Requirements** (___ quarter hours)
___ of the ___ credits required in the baccalaureate core are fulfilled by courses in the strength and conditioning option.

II. **Exercise and Sport Science Core** (___ quarter hours)

EXSS	200	Principles of Computers in Health and EXSS
EXSS	300	Motor Development During Childhood and Adolescence
EXSS	300	Adult Motor Development
EXSS	300	Anatomical Kinesiology
EXSS	300	Biomechanics of Sport and Exercise
EXSS	300	Physiology of Exercise
EXSS	300	Prevention and Care of Athletic Injuries
EXSS	400	Applied Exercise and Sports Physiology
EXSS	400	Therapeutic Modalities
EXSS	400	Administration in Exercise and Sport Science
EXSS	400	Tests and Measurements in Exercise and Sports Science
EXSS	400	Cardiovascular Dynamics

III. **Strength and Conditioning Option Courses** (___ quarter hours)

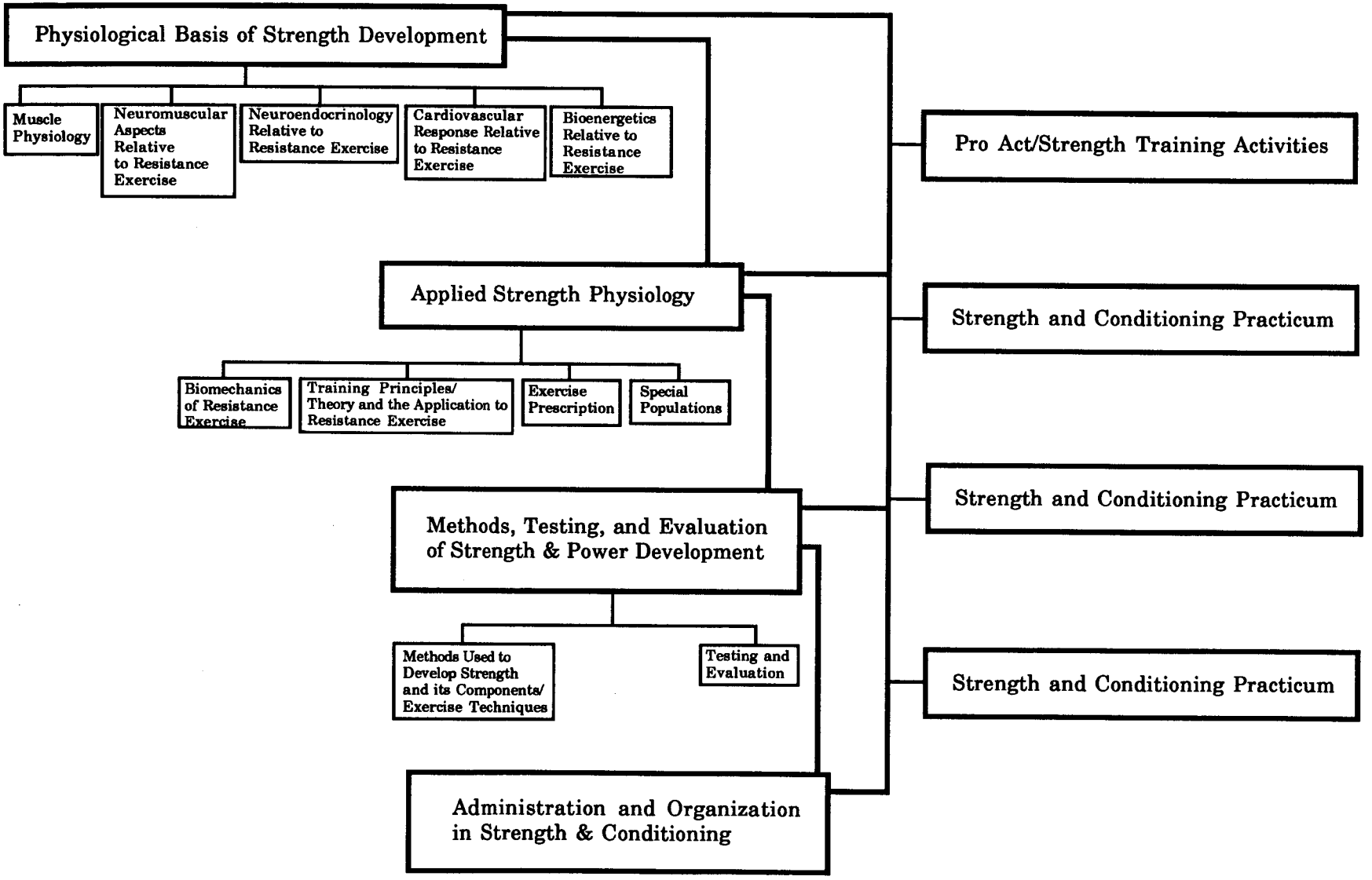
EXSS	400	Physiological Basis of Strength Development
EXSS	400	Applied Strength Physiology
EXSS	400	Methods, Testing, and Evaluation of Strength & Power Development
EXSS	400	Administration and Organization in Strength & Conditioning
EXSS	400	Pro Act/Strength Training Activities
EXSS	400	Strength and Conditioning Practicum
EXSS	400	Strength and Conditioning Practicum
EXSS	400	Strength and Conditioning Practicum

IV. **Supporting Courses** (___ quarter hours)

SP	100	Speech and Communications
NFS	200	Sports Nutrition
ST	200	Statistics
ED	300	Legal Issues

V. **Science and Social Science Courses** (___ quarter hours)

CH	100-03	General Chemistry (or)
CH	200-03	General Chemistry
PH	200-03	General Physics
Z	300-03	Human Anatomy and Physiology
Z	300-03	Elementary Human Anatomy Lab
PSY	200	General Psychology
PSY	300	Human Life Span Development
PSY	400	Abnormal Psychology
SOC	200	Introduction to Sociology
MTH	100	Trigonometry


Physiological Basis of Strength Development
Muscle Physiology
Neuromuscular Aspects Relative to Resistance Exercise
Neuroendocrinology Relative to Resistance Exercise
Cardiovascular Response Relative to Resistance Exercise
Bioenergetics Relative to Resistance Exercise
Applied Strength Physiology
Biomechanics of Resistance Exercise
Training Principles/ Theory and the Application to Resistance Exercise
Exercise Prescription
Special Populations
Methods, Testing, and Evaluation of Strength & Power Development
Methods Used to Develop Strength and its Components/ Exercise Techniques
Testing and Evaluation
Administration and Organization in Strength & Conditioning
Pro Act/Strength Training Activities
Strength and Conditioning Practicum
Strength and Conditioning Practicum
Strength and Conditioning Practicum