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# A Study of the Post-Exercise Heart Rate

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THE wide use of the response of the heart to exercise as a measure of various physical phenomena has led to many and varied procedures. The chief differences in the procedures lie in the variety and strenuousness of the exercise employed, and the phases of recovery used as indices.

Since the most common procedure is to utilize some part of the post-exercise rate, attention is given to this phase in this investigation. The problem is approached by studying the post-exercise response of the heart to bouts of work which have been standardized and measured.

The investigation reported in this study aims to contribute to the understanding of the nature of the response of the normal and the abnormal heart to different intensities of various types of exercise. The response of the heart to various exercises is studied with respect to the following phases: (1) the post-exercise pulse rate, (2) the pulse-ratio, and (3) the recovery time.

Procedure.—For the purpose of counting the heart rate in the investigations herein reported, an automatic counter was devised and has been described. The cardiotachometer is accurate, stable, and simple to operate. It is capable of counting accurately while a simple exercise is performed. The pulse rate is read directly from the counter, thereby eliminating the objection of counting and recording.

The heart rate was recorded in surroundings as free from distractions as possible. The procedure for recording the pulse was as follows: the subject was admitted to the room and directed to strip to the waist. If his chest was extremely hairy he was asked to remove the hair from about a 6-inch square just below the left nipple, with an electric razor. His name, age, and any other historical information desired was recorded and his weight and height were ascertained. The subject reclined on a bed. He was told to lie quietly and to refrain from talking. The cardiotachometer electrodes were attached to the chest and a series of pulse rate recordings were made in the reclining position. The resting rate was recorded in the reclining position, because observations of a continuous record of reclining,

<sup>1</sup> L. E. Morehouse and W. W. Tuttle, "An Electric Pulse Counter," Jour. Lab. and Clin. Med., 24 (August 1930) 1213.

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sitting, and standing pulses reveal that the reclining pulse is the least variable. When the rate attained a steady level it was recorded as the resting rate. The exercise instructions were given and demonstrated by the operator. The subject then assumed the starting position and, when he was ready, the exercise was performed.

The cardiotachometer was started at the end of the last movement of the exercise and the subject was directed to lie on the bed and remain quiet. A continuous recording of the reclining pulse was made until the rate returned and remained at the resting level.

Stool-stepping and weight-lifting were the exercises employed.

The stool-stepping was performed as described by Tuttle.2

A 25-lb. bar-bell was employed in the weight-lifting exercise. The technique was to have the subject stand erect with the weight supported by both hands, at arm's length. At the proper signal, the subject lifted the weight over his head, arms fully extended, lowering it then to the original position of support. The designated number of trials was performed rhythmically with the beat of a metronome.

#### THE POST-EXERCISE PULSE

The Effect of the Strenuousness of an Exercise on the Reliability of the Post-Exercise Pulse Rate.—In order to study the relationship of the strenuousness of an exercise to the reliability of the post-exercise pulse, two separate post-exercise pulse readings following four intensities of stool-stepping exercises were made, and coefficients of correlation were computed. Twenty men acted as subjects. Each subject came to the laboratory and reclined until his pulse rate reached a steady level. He then performed twenty steps on a stool after which his post-exercise reclining pulse was recorded. After his pulse returned to the resting level, it was again recorded after thirty, and similarly after forty and fifty stool steps per minute. Only eleven of the twenty subjects tested could perform fifty steps per minute. Subsequent tests, one to five days later, were made on all subjects.

The reliabilities at the various intensities are as follows:

Steps	Reliability
20	.070
30	.205
40	.720
50	.781

The correlation of two observations of pulse rates following forty and fifty stool steps per minute is high enough to be significant at the 1 per cent level; that is, a coefficient as high as that obtained would occur by chance less than once in a hundred times for samples from an uncorrelated population. The more intense exercises are

<sup>2</sup> W. W. Tuttle, "The Use of the Pulse-Ratio Test for Rating Physical Efficiency," Res. Quart. 2:2 (May 1931) 5.

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strenuous enough to command near-maximum amounts of pulse acceleration which tend to overshadow disturbing factors in the environment. During the light exercises the mildly accelerated pulse is easily further accelerated by extraneous stimuli which make post-exercise pulse readings at these intensities unreliable.

The Pulse Frequency for Thirty Seconds Following Stool-Stepping Exercises of Graded Intensity.—Following observations of the pulse frequency for thirty seconds after stool-stepping exercises, the relationship between the immediate post-exercise pulse and the resting pulse rate was established. Eleven normal male adults were observed in this experiment. The data collected on these subjects is summarized as follows:

Steps per Minute	Mean Pulse per ½ Min. after Exercise	S.D.	Correlation with Resting Rate
10	41.36	5.65	.534
20	46.45	5.83	.513
30	53.73	4.89	.746
40	62.18	7.14	.603

The correlation of the pulse immediately after thirty and forty steps with the resting rate is significant at the 1 per cent level of confidence. Correlations of resting rate with milder exercises although statistically insignificant are also consistently high. An examination of the mean pulse rates for one-half minute following ten, twenty, thirty, and forty stool steps per minute reveals that a direct relationship exists between the post-exercise pulse and the intensity of the exercise.

The Increase in Pulse Frequency Over the Resting Rate Following Stool-Stepping Exercises of Graded Intensity.—What effect does subtracting the resting rate from the rate immediately after exercise have upon the relationship between the post-exercise rate and the resting rate? Using the data collected from the above subjects, the resting pulse frequency for thirty seconds was subtracted from the pulse frequency for the first thirty seconds immediately after four stool-stepping exercises. Correlations of these products with the resting rates were made and are summarized in the following table:

Steps per	Correlation with
Minute	Resting Rate
10	644
20	401
30	402
40	020

Although the correlations are too low to be highly significant, at every intensity of the exercise, a negative correlation is found to exist between the resting pulse and the increase in the post-exercise

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pulse above the resting rate. Individuals with a low resting pulse tend to show a greater increase in pulse rate due to mild exercise and those with the higher resting rates are least affected.

Subtracting the resting rate from the post-exercise rate does, to some extent, counter-balance the effect of the resting pulse rate upon the post-exercise pulse rate following strenuous exercise. This counterbalancing effect does not operate at the milder intensities of exercise.

A comparison of the mean exercise rates with the resting rates shows that a mild exercise (10 steps) increases the pulse only approximately 30 per cent over the resting level. An intermediate exercise (20 or 30 steps) produces only about a 40 per cent increase, while a more strenuous exercise (40 steps) results in more than a 90 per cent elevation in rate.

The Rate of Pulse Deceleration Following Graded Intensities of Exercise.—The pulse deceleration after exercise may be measured by comparing the rate during the first thirty seconds after an exercise with the rate during the second thirty seconds after the same exercise. Observations of the post-exercise pulse deceleration of eleven normal male adults are summarized below:

Steps per Minute	Mean Deceleration	S.D.	Correlation with Resting Pulse
10	5.19	3.03	640
20	10.91	5.91	228
30	14.45	3.60	064
40	15.64	12.76	.135

The post-exercise pulse deceleration rate is inversely related to the resting rate at the mildest intensity of exercise. The greater increase in beats due to the mild exercise in individuals with low resting pulse rates is accompanied by a much faster fall in rate after the exercise. At the strenuous exercise level this relationship does not exist.

By comparing the mean deceleration rates, it is noticed that the deceleration rate increases as the exercise rate is increased.

The Occurrence of a Secondary Rise in Pulse Rate after Exercise in Individuals with Normal and in Cases of Abnormal Hearts.— Following the first fall in pulse rate after exercise there is observed occasionally a secondary rise in pulse rate. This secondary rise usually occurs at about one and one-half minutes after the exercise and is observed to increase as much as ten beats per one-half minute. This rise occurs most frequently after the more strenuous exercises and lasts for about one-half to three minutes.

In order to study the frequency of the occurrence of a secondary rise in heart rate following exercise in individuals with normal hearts

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and others with abnormal hearts, the post-exercise pulse of eleven normal and eight abnormal cases is recorded.

The chi-square test is applied to the data to test the hypothesis that there is no relationship between normality and abnormality of the heart and the factor of secondary rise of pulse rate. Chi-square was found to be .12. Since this value would be found by chance approximately 70 per cent of time, it is impossible to reject the hypothesis that there is no relationship.

#### THE PULSE-RATIO

The Effect of the Resting Pulse Rate on the Pulse-Ratio.—In order to observe the effect of the resting pulse rate on the pulse-ratio, the significance of a difference in means of 29 subjects with resting rates of 58 or less beats per minute and 34 subjects with resting rates of 86 or more beats per minute is estimated by means of the t-test.

The mean pulse-ratio of the low resting pulse rate sample is 2.909, and of the high is 2.757. The value of t is 2.204. In a large number of samples like this, the value of t as large as 2.204 would be found only between 5 per cent and 2 per cent of the time.

With such a high value of t, the hypothesis that the samples were drawn at random from the same population may be rejected and it may be said with a high degree of confidence that the means do differ. Low resting rates are associated with high pulse-ratios and high resting rates with low pulse-ratios.

The Relationship of the Rate of Stool-Stepping Exercise to the Pulse-Ratio.—The linear proportionality between the pulse-ratio and the rate of the exercise reported by Tuttle and others 4.5 does not extend to light exercise. In fact, a stool-stepping exercise of ten steps per minute may produce a higher pulse-ratio than a similar exercise of twenty steps. An observation of the pulse-ratios of five normal subjects tabulated below bears out this relationship.

Subject Number	Pulse-Ratio at 10 Steps	Pulse-Ratio at 20 Steps	Pulse-Ratio at 30 Steps	Pulse-Ratio at 40 Steps
115	2.19	2.13	2.52	3.29
116	2.10	2.09	2.51	3.16
117	2.01	1.97	2.44	3.09
118	2.01	1.97	2.31	2.65
119	2.01	1.99	2.19	2.52

#### THE RECOVERY TIME

The Relationship of the Intensity of Weight-Lifting Exercises to the Recovery Time.—The average recovery times of ten normal male

<sup>&</sup>lt;sup>4</sup> W. W. Tuttle, "Response of the Heart to Exercise of Graded Intensity," Proc. Soc. Exper. Biol. and Med., 29 (March 1931) 598.

<sup>5</sup> W. W. Tuttle and G. Wells, "The Response of the Normal Heart to Exercises of Graded Intensity," Arbeitsphysiol., 4 (Feb. 1931) 519.

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adults after lifting a 25-pound weight 5, 10, 15, 20, and 25 times per minute are tabulated below:

Lifts per	Recovery Time
Minute	in Minutes
5	2.7
10	2.8
15	3.3
20	10.9
25	14.0

An examination of this table reveals that the recovery time is prolonged as the intensity of the exercise is increased. In the majority of subjects, the heart rate returns to the resting level within 3 minutes after 5 to 15 lifts. After 20 and 25 lifts, however, most subjects require 9 or more minutes to recover.

The greatest variation in recovery time between subjects is found when the more intense exercises are used. Everyone responds nearly alike to the mild exercises, 5 to 15 lifts, but after 20 to 25 lifts, a

wide variation is noted.

The Effect of the Resting Pulse on the Recovery Time.—Correlations between the resting rate and the recovery time following the five intensities of weight-lifting exercises performed by the above subjects are shown below:

Lifts per Minute	Mean Recovery Time	S.D.	Correlation with Resting Pulse
5	2.70	2.02	200
10	2.80	1.13	034
15	3.30	1.60	.078
	10.90	7.00	093
20 25	14.00	6.20	266

By referring to this summary it may be seen that there is no significant relationship existing between the resting pulse and recovery time at any intensity of the exercise.

#### SUMMARY AND CONCLUSIONS

The development of an electric cardiotachometer makes possible a more accurate study of certain phases of the response of the heart to various types of exercise, namely; (a) the nature of the recovery of the pulse rate following exercise, and (b) the factors which affect the response of the heart to exercise.

Data on the post-exercise pulse rate support the following con-

clusions:

1. The reliability of the pulse rate for two minutes after exercise is directly related to the strenuousness of the exercise. Thus, if the response of the heart to exercise is to be measured, the exercise must be strenuous enough (40 to 50 stool steps per minute) to overshadow environmental stimuli which affect the pulse rate

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after light exercises (20 to 30 stool steps per minute) to such an extent that successive readings are unreliable.

2. The rate of the first few heart beats immediately following exercise is directly related to the intensity of the exercise and the resting rate.

3. The post-exercise increase in pulse rate above the resting level is directly related to the intensity of the exercise, and at mild intensities of exercise is inversely related to the resting pulse rate.

4. The rate of pulse deceleration following exercise is directly related to the intensity of exercise and the elevation of the pulse rate immediately after exercise. After a very light exercise, it is inversely related to the resting pulse rate.

5. A secondary rise in pulse rate after exercise is a normal, but variable phenomenon.

6. The pulse-ratio of individuals with high resting rates is lower than the pulse-ratio of those with low resting rates. The pulse-ratios are directly proportional to the rate of the exercise except at extremely slow rates, which may produce pulse-ratios higher than the pulse-ratios of faster rates of exercise.

7. The recovery time is prolonged in relation to the intensity of

the exercise and is not related to the resting pulse rate.

8. In general, where exercises are used to differentiate individuals on the basis of the post-exercise pulse rate, the pulse-ratio, and the recovery time, they must be strenuous in order to give reliable results.

SCORING	TABLE	FOR	FUNCTIONAL	STRENGTH	TEST
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Raw	Weighted	Raw	Weighte	d Raw	Weighted	
Score	Score	Score	Score	Score	Score	
30	2.76	26.0 in	22.7	30	109	
.58	259	25.0	213	28	104	
26	244	24.0	202	26	58	
24	227	23.0	188	24	92	
22	212	22.0	177	22	8.7	
20	197	21.0	166	20	8].	
18	1.80	20.0	152	18	7/5	
16	165	1.9.0	1.41	16	.70	
14:	148	13.0	127	1.4	6.4	
12	134	17.0	116	12	58	
10	119	16.0	102	10	52	
8	102	15.0	91	8	47.	
6	87	14.0	777	6	41	
4	172	13.0	66	4	35	
2	55	12.0	54	2	30	
Add	the "Weighted		for the	"Total Scor	re"	

### CLASSIFICATION SCALE

- William Committee and the Committee of			THE RESIDENCE OF THE PROPERTY
Percentile	Values	Score Values and Wichita Class	sification
		360-up (potential athletes)	
90	356		
80	329		
70	309	277-359	Class A
60	292		
50	277		
40	264		
30	250	250-276	Class B
20	232		
10	200	190-249	Class C
		189-down (very poor)	

# Class A (277-up)

(I) Potential Athletes (360-up)

a) Appointment with Athletic Director.

b) List with score, age, height, weight to Athletic Director and Physical Education Office.

(2) Others Above Average (277-359)

- a) Advise strenuous physical education service course along with military science.
- b) List to Intramural Office.

Class B (250-276)

- a) Enroll in moderately strenuous physical education service course along with military science.
- b) List to Intramural Office.

Class C (0-249)

- (I) Men with Functional Weakness but no other Defect
  - a) Appointment for conference with Physical Education Director.
  - b) Enroll in Individually Adapted Physical Education.
- (2) Men with Functional Weakness and Other Physical Defects (same as Cl)
- (3) Mature Students age 25 up (same as Cl)

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There are many instances when the administrator of college physical education needs to know the minimum state requirements for certification of teachers of physical education and also the prerequisite undergraduate work in physical education which is necessary to enter certain graduate schools. Examples of these instances are: 1. Student counciling. Checking the student's schedule to be sure that it includes the course work necessary for teaching in the state in which the student desires to teach, or that which is necessary for entering the desired graduate school in physical education. 2. Curriculum construction. The administrator who includes preparation to meet state certification requirements and graduate college entrance requirements among his objectives in planning the curriculum is desirous of knowing the requirements of at least a few of the nearby states and colleges and universities. 3. Establishing state requirements. Legislators want to know what other states require for certification of teachers of physical education when devising regulations of their own. 4. Establishing entrance requirements for graduate work. In setting regulations for selecting students, the graduate study committee may wish to become familiar with the prerequisites of other graduate schools in order to establish a certain standard,

# PROCEDURE

The survey was made by writing letters to all forty-eight state departments of education and inquiring as to the minimum requirements for certification of teachers of physical education in each state. Letters were also written to sixteen graduate schools of physical education asking for the prerequisite undergraduate work in physical education at each school. 100% replies were received.

Replies were edited to conform to a uniform to a uniform statement of requirements and were then returned to each state and college for checking. When discrepancies arose the requirement was restated and again returned for checking until each statement was finally approved by each state and college. As a few of the states and colleges are now contemplating changes in their requirements, a revision of this data will be necessary within a year from now.(4/3/42)

# RESULTS

MINIMUM STATE REQUIREMENTS FOR CERTIFICATION OF TEACHERS OF PHYSICAL EDUCATION

Alabama: Bachelor's degree with a minor of 12 semester hours in physical education and a minor of 12 semester hours in education.

Arizona: Graduation from a regular four year course with 30 semester hours in physical education and 18 semester hours in psychology and education not including practice teaching.

California: A four year college course with a bachelor's degree including 24 semester hours in physical education and 15 semester hours of professional work in education. Must be physically and mentally fit to engage in teaching service. Minimum of 15 semester hours in the fields of English, science, social studies and physical education. Minimum of 15 semester hours from at least four of the following; 1. Biology, 2. Anatomy, 3. Physiology, 4. Hygiene, 5. Psychology. 6. Sociology, 7. Chemistry. Minimum of 24 semester hours

selected from at least seven of the following, with a minimum of 6 semester hours in activities in physical education: 1. Principles of physical education, 2. Techniques of teaching activities, 3. Administration of physical education, 4. Kinesiology (applied anatomy), 5. Applied physiology (physiology of exercise), 6. Activities in physical education, 7. Community recreation, 8. Individual program adaptations (corrective physical education), 9. Physical education tests and measurements, 10. Health education, 11. Growth and development of the individual. Colorado: 90 quarter hours (60 semester hours) of collegiate training including 15 quarter hours (10 semester hours) in education. The special requirements in physical education are: 1. Corrective gymnastics...3 quarter hours. 2. History of physical education...3 quarter hours. 3. Methods in formal activities... 2 quarter hours. 4. Methods in play activities... 5 quarter hours. 5. Practice work in formal and play activities... 5 quarter hours. 6. Organization and administration... 3 quarter hours. 7. Hygiene and first aid... 6 quarter hours. 8. Physiology (including physiology of exercise)... 6 quarter hours. 9. biology...3 quarter hours. 10. Anatomy and kinesiology...6 quarter hours. 11. Physical examination...3 quarter hours. 12. Methods of health education...l quarter hour. Connecticut: Approved four year teacher training course in physical education in an institution approved by the State Dept. of Education. Delaware: The work of a bachelor's degree satisfactorily completed in a standard college or university and specialization in physical education to the extent of at least 60 semester hours including: Methods of teaching physical education ... 6 semester hours. Practice teaching ... 6 semester hours. Professional subjects ... 6 semester hours. Florida: Graduation from an institution which requires 4 years' training; with 6 semester hours each in science, social studies, and English; with 18 semester hours in education, not including psychology courses, and with 21 semester hours in health education and physical education, of which not more than 9 semester hours may be coaching courses. If college courses do not include 6 semester hours in American history and government, an examination on the constitution of the United States must be passed. Georgia: 90 semester hours of college work including 9 semester hours of approved education and 12 semester hours of physical education. A professional certificate would require credit for 18 s.h. in education. Idaho: 64 semester hours of which 15 semester hours is in education and 25 semester hours is in physical education. Illinois: If the applicant teaches physical education where it is required for graduation, the applicant must have had 16 semester hours of work in health and physical education, 4 hours of which must be in physiology, anatomy, kinesiology, hygiene, health, safety or other related subjects. Only 4 semester hours is required if he teaches in a school where physical education is not required for graduation. The appliant must in all cases have 15 semester hours of education. Indiana: Graduate with a baccalaureate degree with 15 semester hours in education. Also 24 semester hours of physical education which shall include; Gymnastic exercises... 3 semester hours. Theory and practice of play...3 semester hours. Coaching of athletics...5 semester hours. (Women may substitute to the extent of 3 semester hours in theory of rhythm courses) General physiology, anatomy, health education... 5 semester hours. Physical examinations and individual gymnastics...3 semester hours. Electives (not coaching of athletics). They may be chosen from organization and administration of physical education, physical diagnosis, or first aid. Iowa: A degree or diploma from an institution approved by the board of educational examiners. This degree shall include 15 semester hours of professional training and not less than 20 semester hours in physical education including; courses covering principles, administration, methods and supervision of physical education... 6 semester hours. Courses covering methods of specialized physical education activities (credit given only for lecture hours)...10 semester hours, A teacher may teach physical education in a small high school with less than four teachers if he has had a minimum of 4 semester hours of physical education. A teacher may teach physical education less than half time if he has had 10 semester hours training in physical and health education.

Kansas: An applicant who will teach in a school where credit in physical education is required for graduation must have graduated from a 4 year college. He must have had 15 semester hours in physical education, 10 hours of which must ben in the field of health, physiology, first aid, or school hygiene and 18 semester hours in education. Kentucky: Bachelor's degree with a major of 24 semester hours or a minor of 18 semester hours and with 24 semester hours in education including 6 hours of practice teaching and 3 hours of material and procedures of teaching physical education in elementary and secondary schools. Louisiana: A four year degree with 42 college session hours or 9 semester hours in physical education. He is authorized as a part time special teacher if he has a minor of 9 college session hours or 18 semester hours; a full-time special teacher if he has a major of 20 college session hours or 40 semester hours. (A definitely established evaluation of the distribution of these hours is done by the director of certification with the cooperation of the state supervisor of health, physical, and safety education) Maine: Graduate from a 4 year college. Must have had 12 semester hours in the field of physical education, 6 hours of which must be in the field of biology and physiology. Maryland: 16 hours in education. 30 hours in physical ed. as follows: I. Foundation sciences to include: A. Anatomy and physiology (concurrently or combined), B. Personal Hygiene, C. Community hygiene. II. General Education to include: A. Special methods (single, dual sports; self-testing activities; and dancing), B. Special methods (team games), C. Special methods (health methods and materials), D. Growth and development of the child, E. Practice teaching. III. Health and Physical Education: A. Physical education activities, B. Introduction to physical education, C. Protection and emergency care of injuries, D. Nature and teaching of play, E. Administration of physical education, F. Leadership organization, G. Mechanical analysis of activities and mechanical-anatomical analysis of activities, H. Physiology of activities. Methods and practice teaching. Grade of at least C in practice teaching. Class rank - upper four-fifths. Massachusetts: Each local school committee makes its own regulations concerning the qualifications of teachers in their schools. Michigan: Graduate with a Bachelor's degree which includes 20 semester hours of education with either a major of 24 semester hours in physical education and health and two minors in academic subjects or a minor of 15 semester hours in physical education and health, one academic major, and one academic minor. Minnesota: For less than one half time work in physical education the

Minnesota: For less than one half time work in physical education the teacher must be a graduate from a four-year college and must have had fifteen semester hours in physical education. Eight semester hours of the fifteen must be in skills plus teaching technique, and the remaining seven semester hours in theory courses in health and physical ed. For full time work in physical education (work requiring half or more of the teachers time), an approved four year teacher training course of thirty-six semester hours in physical education in an institution approved by the State Department of Education is required.

Mississippi: Recommends a 120 hour course which consists of 21 sem. hours of physical education and 18 semester hours of professional education and 18 semester hours of professional education. At the present the approval of these teachers is left up to the discretion of the high school supervisor.

Missouri: Baccalaureate degree with 18 hours of education courses and 24 hours of physical education courses which include work in health, physiology, physical activities, and recreation.

Montana: A degree from a four year college. This degree will contain  $22\frac{1}{2}$  quarter hours in education and 48 quarter hours in physical ed.

Nebraska: Complete a four year college teacher training course of study which includes a mininum of 15 semester hours in physical ed.

Nevada: Bachelor of Arts or Bachelor of Science degree which includes 18 semester hours training in the field of professional education including four semester hours of practice teaching. The majority of the hours in educational subjects must be in the secondary field.

New Hampshire: Graduate of a standard post-secondary institution designed to train teachers of physical education and complete 12 semester hours of work in education.

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New Jersey: An approved degree in a four year physical education teacher preparation curriculum, with 12 semester hours in English language and literature; 12 in social studies, 6 in science, 18 semester hours in the study of secondary education.

New Mexico: A college degree with appropriate majors and minors with a minimum of 10 semester hours in physical education.

New York: Approved four year curriculum leading to the baccalaureate degree including 18 semester hours in professional education courses and 36 semester hours of physical education. The special courses required are: Prerequisites; General anatomy...2 semester hours, General physiology...4 semester hours, Biology...6 semester hours, Hygiene... 2 semester hours, Elective science... 4 semester hours. Fields; Applied anatomy...2 to 4 semester hours, Physiology of exercise ... 2 to 4 semester hours, Physical inspection, first aid and safety education... 2 to 4 semester hours, Physical education for atypical children...3 to 4 semester hours, Physical education tests and measurements... 3 to 4 semester hours, Community recreation... 4 to 6 semester hours, physical education skills and applied technics...14 to 16 semester hours.(a) Group games of low organization...men 2, and women 2 semester hours, (b) Dual and single games...men 3, and women 3 semester hours, (c) Group games of high organization...men 3, and women 2 semester hours, (d) Rhythms and dances...men 2, and women 4 semester hours,(e)Gymnastics and stunts...men 3, and women 2 semester hours, (f) Aquatics...men 1, and women 1 semester hour.

North Carolina: 30 semester hours major in order to teach full time. 6-8 semester hours of biological and physical science, 6-8 semester hours of social sciences are recommended as prorequisites. Human anatomy and physiology...6 semester hours. Frinciples, organization, administration, supervision of physical education and health education ...3-4 semester hours. Physical education skills and applied techniques...12 semester hours. (Group games of low organization, rhythms and dances, gymnastics and stunts, aquatics) Individual corrective physical education...2-3 semester hours. Hygiene...3-4 semester hours. Methods and materials in health education 2-3 semester hours.

North Dakota: Bachelors degree with 16 semester hours in education and a minor or major in physical education.

Ohio: Graduate from a four year college course which includes 17 semester hours in professional preparation and minor of 16 semester hours in health and physical education which shall be distributed as follows: Principles, organization, and administration of health and physical education...4 semester hours. Theory and practice including stunts, apparatus, tumbling, swimming, dancing, etc...4 semester hours. Theory and practice including athletic coaching in intramural and inter-scholastic athletics...4 semester hours. Health education, including teaching of health and school health problems...4 sem. hours. A major in health and physical education consists of 40 semester hours.

Oklahoma: 90 semester hours of college training, 10 semester hours of which is in education courses, and 17 semester hours of which is in physical education courses including: Activity or participation courses...8 semester hours. First aid...l semester hour. Boy and girl leadership...2 semester hours. Anatomy...2 semester hours. Theory of activities including theory of intramurals...4 semester hrs.

Oregon: Baccalaureate degree with 37 quarter hours of professional education and 12 quarter hours each of physical education & health ed.

Pennsylvania: Four year teacher training curriculum including 18 semester hours of education and 30 semester hours in physical education, courses which should be equally distributed among; health education, physical education, and theory, organization and administration, and student teaching in health and physical education classes.

Rhode Island: Graduate of a four year college course which includes 400 clock hours in education and 400 clock hours in physical education.

South Carolina: Major in physical education. Requirements now being revised will not be published until spring, 1942.

South Dakota: Bachelor's degree which includes 15 semester hours in education and 15 semester hours in physical education.

Tennessee: Graduate from a four year college or university. Course must have included 27 quarter hours in education and at least 18 quarter hours in physical education.

Oktahoma; 90 semester hours of edliges training; 10 simester hours of

Texas: 60 semester hours of college work which include 6 semester hours in education, and 8 semester hours in physical education, 2 semester hours of which is in the methods of teaching physical educ.

Utah: A college course of four years which includes 30 quarter hours in education, 8 quarter hours in health, safety and physical education, together with a teaching major of at least thirty hours and a teaching minor of 18 hours. It is not required that the major or minor be in physical education, but it is strongly recommended.

Vermont: Baccalaureate degree in physical education. This degree must also include a minimum of 12 semester hours in education courses.

Virginia: Baccalaureate degree which shall include six college session hours (12 semester hours) in physical education and nine college session hours (18 semester hours) in teacher training courses.

Washington: Five year course designed for the training of teachers. This course must include 24 quarter hours in education and a minor (18 quarter hours) in physical education is recommended.

West Virginia: Graduate from a standard college with a minimum of 20 semester hours in education and 24 semester hours in physical education which shall include: Anatomy, physiology and kinesiology...4 sem. hrs., Health education and hygiene ... 4 semester hours, Principles, organization and administration of health and physical education ... 2 sem. hrs., Physical inspection and correction of remedial defects...l sem. hour, Theory and practice of physical education... 13 semester hours, Team sports, .. men 5, women 3 semester hours, Recreation activities... men 3, women 3 semester hours, School and community and men 4, women 4 semester hours, Rhythms...men 1, women 3 semester hours.

Wisconsin: Graduate from a four year course which includes 18 semester hours of education and a major of 30 semester hours in physical educ.

Wyoming: Graduate from a four year course which includes 18 semester hours of education and a major of 30 semester hours in physical educa Summary

1. As there is little agreement among state laws as to certification of physical education teachers, a student preparing to teach physical education must select courses which meet the requirements of the state in which he desires to teach. It is almost impossible for a student to prepare to meet the requirements of all states during a 4-year college course.

2. In preparing the major's curriculum in physical education, the committee should select appropriate courses so that the graduate could teach in any nearby state following additional courses in one summer

school just preceding his job. 3. In order to be eligible to be certified to teach physical education in all of the United States, an individual who is physically and mentally fit to engage in teaching service" would be required to have the following preparation: A total of 135 semester hours, ranking in the upper four-fifths of the class, leading to a bachelor's (four-year) degree in a standard (approved) college or university including 24 semester hours in professional education (teacher training) courses, 42 hours of prerequisites, and specialization in physical education courses to the extend of at least 71 semester hours including; A. Prerequisites .- 1) Biology, 6.s.h.; 2) General anatomy, 2 s.h.; 3) General physiology, 4 s.h.; 4) Personal hygiene, 2 s.h.; 5) School and community hygiene, 2 s.h.; 6) English, 4 s.h.; 7) American History and Government, 6 s.h.; 8) Psychology, 4 s.h.; 9) Sociology, 6 s.h.; 10) Growth and development of the child (individual), 2 s.h.. B. Fields. - 1) Practice teaching in physical and health education (grade of at least C), 6 s.h.; 2) Applied anatomy (kinesiology) (mechanical-anatomical analysis of activities), 4 s.h.; 3) Applied physiology (physiology of exercise) (physiology of activities), 2 s.h.; 4) Mechanical analysis of activities, 2 s.h.; 5) Physical education for atypical children (corrective gymnastics), 3 s.h.; 6) Physical Education tests and measurements, 3 s.h.; 7) Physical examination (inspection), 2 s.h.; 8) Protection and emergency care of injuries (first aid and safety education), 2 s.h.; 9) Introduction to physical education, 2 s.h.; 10) History of physical education, 2 s.h.; 11) Administration, organization, supervision, and principles of physical education and hygiene, 4 s.h.; 12) Methods and materials of health and safety education, 3 s.h.; 13) Methods (techniques) of teaching formal activities (gymnastic exercises), 3 s.h.; 14) Methods (techniques) of teaching single and dual sports, 2 s.h.; 15) Methods (techniques) of teaching team games, 2 s.h.; 16) Coaching of intramural and interscholastic athletics (men), 5 s.h.; 17) Nature and teaching (theory and practice) of play, 3 s.h.; 18) Direction of recreational activities, 4 s.h.; 19) Community recreation, 2 s.h.; 20) Boy and girl leadership,

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2 s.h.; 21) Theory and practice of group games of low organization, 2 s.h.; 22) Theory and practice of group games of high organization, 3 s.h.; 23) Theory and practice of dual and single games, 3 s.h.; 24) Theory and practice of Rhythms and dances, 4 s.h.; 25) Theory and practice of aquatics, 1 s.h..

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PREREQUISITE UNDERGRADUATE WORK IN HYSICAL EDUCATION NECESSARY TO ENTER CERTAIN GRADUATE SCHOOLS OF PHYSICAL EDUCATION

University of California at Los Angeles: 1. A grade point average of 1.5 for his total undergraduate work. 2. A grade point average of 1.75 for his upper division major curriculum. 3. An equivalent of the major courses offered at the University of California. The major includes work in kinesiology, physiology of exercise, correctives, tests and measurements, technic of sports, administration of health, athletic injuries, adiministration of physical education, administration of community hygiene, first aid, etc.

University of Southern California: An undergraduate major of at least 24 to 30 units in physical education to pursue the Master of Arts degree or a minimum of 12 units each in the fields of education and physical education to pursue the Master of Science in Education degree.

Columbia University: The possession of the bachelor's degree from an approved institution of higher learning. If a student enters without a major or minor in physical education he must complete at least 8 semester hours credit before he can pursue an advanced degree in health and physical education.

University of Iowa: 30 semester hours of undergraduate credit in physical education and allied subjects as follows: Hygiene...6 semester hours. Anatomy...3 semester hours. Kinesiology...3 semester hours. Human physiology...6 semester hours. Theory and practice or techniques ...12 semester hours. The North Central requirements in Education must be completed. If not it must be done in the graduate work.

Univerisity of Illinois: 20 semester hours of approved undergraduate work in physical education, but students who present evidence of satisfactory experience in the field of physical education may have the requirement reduced.

University of Michigan: A minor of 17 semester hours in physical educ. which should include physiology, hygiene, community recreation, student teaching, introduction to physical education, and activity courses.

New York University: A major in physical education is not required but it is recommended. The undergraduate work should include courses in anatomy and kinesiology, history and principles of physical education, hygiene, tests in physical education, skill techniques, practice teaching, administration, supervision and organization of health, physical education and recreation, etc.

University of Minnesota: Previous work or experience in physical education but he must complete the following undergraduate courses before he may obtain his masters degree: Science courses - human anatomy, physiology, applied anatomy (mechanics of movement, kinesiclogy)...9 quarter hours. Physical education activities...12 quarter hours. Professional physical education courses...9 to 15 quarter hours. Methods and directed teaching in physical education...9 quarter hours. Total 39 to 45 quarter hours.

University of Oregon: 1. Physical education laboragory...18 hours.

2. Physiology, anatomy or body mechanics...9 hours. 3. Health education...12 hours. 4. Principles of physical education, organization and administration of physical education or tests and measurements...

9 hours. 5. Coaching group activities...6 hours. 6. Training and conditioning or first aid...2 hours. 7. Special techniques, or playground and community recreation organization...3 to 4 hours.

8. Miscellaneous: dietetics, rhythmics, correctives, etc...2 to 3 hours. Total 61 to 63 credit hours.

George Peabody Collège for Teachers: Enough work in physical education to fill the following group requirements: 1. History of physical educ., the principles of physical education, and organization and administration ... 6 quarter hours. 2. Personal techniques, in skills, or the performance of various physical education activities... 6 quarter hours. 5. Methods of teaching physical education and coaching methods... 6 quarter hours. 4. Courses in health education and hygiene... 6 quarter hours. Also human anatomy, physiology, or kinesiology or combination of any of these totaling at least 7 quarter hours.

Springfield College: Minimum of 20 semester hours in health and physical education background courses for Master of Education and 30 semester hours for Master of Physical Education. The background materials include biology, physiology, anatomy, chemistry, and activities in physical education grouped into three areas: first, aquatics; second, gymnastics; third, major sports. He must possess a good background of personal hygienic living, experience in competitive sports, camping, and other recreational activities; a bachelors degree with scholastic standing better than average, high standars of ethical conduct, and a good physique.

Syracuse University: 1. Bachelor's Degree from an accredited institution. 2. An undergraduate major in physical education which in this state (N.Y.) consists of 36 hours of physical education plus the basic sciences of chemistry, biology, human anatomy, and physiology.

University of Texas: An undergraduate major in physical education which includes 6 semester hours of physical education courses of which 12 semester hours must be junior-senior courses. Also 18 semester hours of education, 6 of which are junior-senior courses.

Texas State College for Women: A major in physical education or health which is similar to the major offered at this college.

Wellesley College: A bachelor's degree which includes the following courses: Chemistry one year if not taken in high school, psychology one semester, principles of education one semester, mammalian anatomy 4 to 6 semester hours, physiology 6 semester hours, French or German reading knowledge to be demonstrated in an examination given prior to admission. 6 semester hours to be chosen from these fields: bacteriology, hygiene, physics, psychology, sociology. It is desirable to have completed before admission at least an elementary course in several physical education activities.

West Virginia University: A bachelor of science degree in physical education which shall include courses in the theory and practice of physical education, theory and practice of recreation, health education, safety education and other courses which furnish a background for physical education.

# Summary

1. Most graduate schools of physical education require the equivalent of their own undergraduate major as a prerequisite to graduate work, but a few of these required undergraduate courses may be carried while the student is doing graduate work. These prerequisites include both background and allied subjects as well as physical education subjects. Therefore, it would be wise for the undergraduate to prepare himself for graduate work in a certain school by following, in general, the undergraduate work in the physical education curriculum of that school. 2. Many graduate schools of physical education allow substitution of courses or experience in physical education for certain prerequisites. Thus, in submitting records in making application for entrance in graduate work, it is important to state a description of each undergraduate course and an outline of all experience in physical education. 3. In order to be able to enter all of the selected graduate schools without having to carry further undergraduate work along with the graduate curriculum, the student would have to have the following prerequisites: A bachelor's degree with a scholastic standing better than average from an accredited (approved) institution of higher learning with an undergraduate major in physical education of 36 semester hours, also 18 semester hours of education, 6 of which are junior-senior courses. He must possess a good background of personal hygienic living, experience in competitive sports, camping, and other recreational activities; high standards of ethical conduct and a good physique; and successful completion of the following subjects: A. Allied Subjects. - Biology, human (mammalian) anatomy. . . 4 s.h., human physiology...6 s.h., hygiene...6 s.h., administration of community hygiene, psychology, sociology, chemistry, physics, bacteriology, dietetics, French or German (reading knowledge). B. Physical Education Subjects. - Directed (student) teaching in physical education...6 s.h., applied anatomy (kinesiology) ... 3 s.h., body mechanics, correctives, tests and measurements in physical education, first aid (athletic injuries), safety education, training and conditioning, introduction to physical education, history of physical education, principles of physical education, health education, playground and community recreation organization, physical education laboratory (skill: or performance of various physical education activithes) (theory and practice or techniques)...12 s.h., methods of teaching physical education theory and practice of recreation, community recreation, aquatics, gymnastics, major sports, rhythmics, special techniques, coaching (group activities) methods. 4/3/42