CHRONIC ALTERATIONS IN JOINT FLEXIBILITY
ASSOCIATED WITH AEROBIC DANCE INSTRUCTION
OF COLLEGE AGE FEMALES

THESIS

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by

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The purposes of this study were (1) to determine if three selected aerobic dance related conditions would result in chronic alterations of flexibility of college women and (2) to compare flexibility measures of college age females during a semester of aerobic dance instruction. Subjects were sixty-three college women enrolled in aerobic dance, bowling, and archery classes. Eight flexibility measures were obtained during the third and eleventh weeks of the experimental period. Data were analyzed by a factor analysis, the Pearson Product Moment Correlation, and eight one-way analyses of covariance. Conclusions of the investigation were (1) a program of aerobic dance alone is not sufficient to promote flexibility, and (2) supplemental flexibility activities of ten minutes duration used with aerobic dance training are beneficial in increasing hip flexion.
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CHAPTER I

INTRODUCTION

In recent years an increasing awareness has developed in the American population with regard to physical fitness. Concern on the part of the general public can be evidenced in part by the growing body of literature dealing with this subject. There is little question concerning the need or value of persons engaging in some type of physical activity program to promote increased levels of physical fitness. One such program is aerobics which was developed by Dr. Kenneth Cooger (1, 2).

An aerobics program has as its primary benefit the development of the cardiovascular system. Other benefits include increased muscle tone and weight loss. Various forms of aerobic activities include cycling, swimming, walking, jogging, and running. Aerobic dance was created by Jacki Sorensen as an alternative to other aerobic activities (6, 11, 12, 13).

Aerobic dance consists of a series of simple vigorous routines choreographed to popular music. The steps are simple enough for the beginner to perform yet challenging for the more advanced aerobic dancer and can be performed
at any desired level of intensity (11). Both the commercial and instructional programs have gained an ever-increasing number of followers and continue to grow at a phenomenal rate (6, 13).

If educational institutions are to continue offering aerobic dance as a fitness-oriented class, then the exercise mode should contribute to the most basic components involved in physical fitness. These components are strength, flexibility, and endurance.

Research by Hart and Patton (5) has determined that aerobic dance provides a beneficial increase in the cardiovascular system as determined by endurance testing. Sorensen has made the statement that flexibility is another benefit achieved through aerobic dance (11, 12, 13). However, this statement has not yet been proven true.

Interest in flexibility as an element of physical fitness has increased following the report of a large number of failures by American youth as compared to European youth on the flexibility item in the Kraus-Weber fitness battery (7). It is now a generally recognized belief that an adequate degree of flexibility is important to general health and is needed for successful performance in dance, sports, and daily tasks (9). deVries (3) states that lack of flexibility can create disorders or functional problems for many individuals. A person with a stiff spinal
column is at a disadvantage in many physical activities and fails to receive full value from the shock-absorbing arrangement of the spine when walking, running, or jumping. The individual who does not have good range of movement is more likely to incur torn ligaments than the person with a good range of motion. He further notes that it is impossible to state how much flexibility is desirable, but everyone should strive to prevent loss of flexibility during the aging process.

Recognizing this need for flexibility, Sorensen has arranged each aerobic dance session to include stretching exercises both prior to and following a session. She has also choreographed stretching movements into the routines and the rhythmical sit-up routine. All of the stretches, with the exception of those in the sit-up routine, are performed in a standing position. The sit-ups are performed in a seated straddle position and were designed to enhance hamstring flexibility (13).

It was hoped that this study would provide information concerning possible chronic gains in flexibility as attributed to Sorensen's Aerobic Dancing when taught in a university setting. It is not known whether added flexibility activity is necessary when instructing aerobic dance. Moreover, it is not known whether added flexibility activities in addition to aerobic dance invoke changes in flexibility.
Finally, it is not known whether the selected flexibility activities used in aerobic dance are any more effective than other selected flexibility programs used with aerobic dance for the purpose of increasing flexibility.

Statement of the Problem

This study was designed to determine and compare the possible chronic flexibility gains achieved through aerobic dance under one of the following conditions:

1) aerobic dance performed without a series of stretches used as a warm-up or cool down;

2) aerobic dance performed with a series of stretches designed by Jacki Sorensen as the warm-up and cool down;

3) aerobic dance performed with a modified version of the NTSU Stretch and Flexibility Program as the warm-up and cool down.

Purposes of the Study

The purposes of this study were:

1. To determine if three selected aerobic dance related conditions would result in significant chronic alterations of selected flexibility measures of college age females during a semester of aerobic dance instruction,

2. To compare flexibility measures of college age females during a semester of instruction in aerobic dance.
Definition of Terms

1. **Aerobic dancing.**—"a program of physical fitness which involves simple, vigorous dancing for the non-dancer" (11, p. 7).

2. **Dynamic stretching.**—"a stretching which involves bobbing of the body or a body segment" (14, p. 378).

3. **Extension.**—"the return movement from flexion" (14, p. 11).

4. **Flexibility.**—"the ability to move a joint through its full range of motion" (11, p. 14).

5. **Flexion.**—"a movement in which the angle of a joint decreases" (14, p. 11).

6. **Jacki Sorensen's stretches (operational).**—a series of exercises designed by the originator of aerobic dance to be utilized as part of the warm-up and cool down in an aerobic dance session.

7. **NTSU Stretch and Flexibility Program (operational).**—a series of exercises designed by the North Texas State University athletic staff to be used as a warm-up and cool down by the intercollegiate football team.

8. **Static stretch.**—"holding a muscle in a stretched position for a period of time" (3, p. 73).

Delimitations of the Study

This study was delimited to the testing of flexibility of women enrolled in three aerobic dance classes and women
in bowling and archery classes at North Texas State University, Denton, Texas, during the spring semester, 1978. The study was also delimited to eight selected flexibility measures obtained using the techniques described by Harris (4) and the instrument developed by Leighton (8). Finally, the study was delimited to the chronic effects of flexibility.

Limitations of the Study

The limitations of the study were

1. The effects of outside activity influence flexibility. However, physical activity outside the classroom was not controlled,

2. Measurements for all subjects were not taken on the same day nor at the same time of day.

Probable Value of the Study

The principal value of this study was to determine the contributions of aerobic dance to flexibility. Furthermore, the study sought to compare possible benefits of aerobic dance performed under one of three stretching conditions.

The results may be used in an instructional setting to improve and/or increase the fitness benefits which the physical educator can offer the individual student through a program of aerobic dance. An alternative to the regular stretching program used with aerobic dance was suggested
which resulted in benefits equal to those attributed to Sorensen's stretch program when used in conjunction with aerobic dance. In addition, the study resulted in some groundwork upon which Jacki Sorensen can base her claims of increased flexibility as achieved through her public school aerobic dance program.
CHAPTER BIBLIOGRAPHY


CHAPTER II

REVIEW OF LITERATURE

A review of the literature revealed a limited number of studies directly related to aerobic dance. There was, however, an extensive body of literature in the area of flexibility. Studies related to flexibility measurement, relationships of flexibility to selected physical aspects, and the specificity of flexibility are included.

Aerobic Dance

Aerobic dance consists of a series of simple routines which improve and maintain cardiovascular and muscular fitness (35, 37). This activity involves a mixture of rhythmic running, hopping, skipping, jumping, sliding, stretching, swinging, and other locomotor movements. Each routine is choreographed to fit the mood and style of its music. Aerobic dancing has two basic objectives: 1) developing fitness and 2) providing fun (35, 36, 37).

Aerobic dancing was originated in 1969 by Jacki Sorensen. She developed it as a fitness activity for women at an Air Force base in Puerto Rico. Upon her return to the United States, she rapidly expanded the program to
YWCA's and college campuses. Currently aerobic dance is taught in several states and many foreign countries. Separate programs have been developed for men and boys, women, elementary age children, and secondary school students.

A session of an aerobic dance class begins with basic warm-up stretches then proceeds to the rhythmic sit-up routine followed by a warm-up dance routine to music (13). "This routine gradually loosens up tense muscles and increases flexibility." (35, p. 18) The warm-up period is followed by a twenty to thirty minute session of vigorous dancing. The class is concluded with at least a five minute cool down during which "the participants perform slow stretching movements combined with gentle dance steps and walking patterns." (35, p. 18)

The program's primary objective is to improve aerobic fitness. Weber (40) investigated the energy cost of aerobic dance by measuring the oxygen uptake of ten women participating in a forty-five minute aerobic dance session. Measurements were taken by means of a portable respirometer worn on the back. Following the routine the oxygen consumption was measured. It was found that aerobic dance served as a highly strenuous activity comparable to such activities as jogging, cycling, and handball. Weber also stated that when aerobic dance is performed regularly at a
level which produces a cardiovascular stress, an aerobic training effect will result (40).

Rockefeller and Burke (31) also studied the energy cost of aerobic dance as well as the psycho-physical effects of a ten-week aerobic dance program in twenty-one college age women. Multiple analysis of variance computed between pre- and posttests for six dependent variables revealed significance at the .05 level. Univariate t-tests and analysis of mean changes revealed increases in maximal oxygen uptake, maximal ventilation, maximal working capacity, and body weight and decreases in submaximal working heart rate and submaximal rating of perceived exertion. The researchers concluded that the aerobic dance training program employed was of sufficient energy cost to elicit significant physiological and psychological alterations in college women.

Hart and Patton (9) reported a significant increase in the cardiovascular endurance of thirty-one college age females enrolled in aerobic dance conditioning classes at North Texas State University. Posttest scores on the Cooper 12-minute walk-run test indicated a mean increase of .45 laps on a 440 yard track. Resting heart rates decreased from 76.58 ± 12.53 beats per minute to 69.55 ± 10.53 beats per minute. This decrease proved significant at the .05 level of probability.
Besides improving aerobic fitness, Sorensen (35, 36, 37) stated that aerobic dance helped participants develop better coordination, flexibility, muscle tone, agility, and balance. No research could be found in the literature supporting any part of this statement.

Flexibility

Leighton (24) stated that flexibility refers to one element of body movement, that is, the range of movement of the different body segments at the various joints of the body. Movement of any body segment with respect to another segment is almost universal in some form for all parts of the body. Jensen and Schultz (12) added that flexibility is a condition of muscle and connective tissue which contributes to range of motion. This range of motion is dependent upon three factors (12, p. 182):

1. bone structure of the joint itself;
2. amount of bulk (muscle and tissue) near the joint, which may restrict movement;
3. elasticity of the muscles, tendons, and ligaments around the joint.

Inadequate range of motion in certain joints may restrict a person's ability to perform (24). Kraus (31) has also found that lack of flexibility contributes to lower back pain.
Wells (41) lists three kinesiologic forces commonly used to increase flexibility (p. 387):

1. the force of gravity;
2. momentum, or the force of motion;
3. the force provided by either another person or some part of one's own body, that is, a pushing or pulling force.

Any one of these forces may be used in implementing a regular program of exercises which stretch muscles and connective tissues in opposition to a particular movement. In the case of stretching, inhibitory impulses to the antagonist muscles are essential. Slow stretching results in the blocking of impulses and the release of tension in the muscles, consequently allowing a greater degree of stretch (12).

Ballistic or dynamic stretching has been found effective in developing flexibility (4). However, fast forceful bobbing as a form of stretching induces the stretch reflex which could injure muscle tissue. The stretch reflex contraction varies directly in the amount and rate with the amount and rate of movement that causes the stretch. The faster and more forcefully the muscle is stretched, the faster and more forceful the reflex contraction. Static stretch will not induce the stretch reflex contraction and it involves a lesser danger of exceeding the extensibility limits of the tissue involved than does ballistic stretching (4).
Measurement of Flexibility

There are basically two types of flexibility measures. The first is "single joint action which consists of the body when only one joint action is involved." (8, p. 592) The most common device to measure joint action is a manual goniometer (8). Moore (20) groups the goniometers into two classes: 1) instruments of universal application to all joint actions and 2) instruments designed to measure a single range of motion for a specific joint.

A more recent device to measure flexibility is the flexometer as devised and described by Leighton (21, 23). The instrument consists of a weighted 360 degree dial and a weighted pointer mounted in a case which is strapped to the body part being measured. Reliability estimates ranged from .889 to .997 for test-retest of two trials in the original work (23). Leighton (18, 23) states that the flexometer takes measurements in units universal to all movements (degrees), the measures are free from effects of variation in length and breadth of body segments, and the instrument is applicable to measuring actions of all segments. Other reported reliabilities include correlation coefficients of .913 to .966 by Leighton (18), .901 to .966 by Leighton (23), .911 to .972 by Hupprich and Sigerseth (11), and .929 to .988 by Laubach and McConville (17).
Harris (8) reports that Karpovich developed the electrogoniometer, or elgon, which is a goniometer with a potentiometer substituted for the protractor. Its main advantage is its ability to record joint motion during activity. However, few joints can be measured with the elgon.

Harris (8) remarked that "the Leighton flexometer appears to be the most objective instrument for measuring joint action." (8, p. 592) Both the manual and electrogoniometer require the arms of the instrument to be placed directly over the line of the bones of the joint being measured. Because the Leighton flexometer uses gravity as its origin, the goniometer positioning is not required when using it.

A second type of flexibility measurement measures composite action, which consists of the extent of movement when more than one joint or more than one type of action within a single joint is used (8). Several physical fitness batteries contain a flexibility measure which is usually of this type. According to Harris (8), "this practice is based on the assumption that flexibility characteristics within the body are of a general nature, i.e., they vary systematically for the various joint actions or combinations of them." (p. 62) Several of the composite measures involve flexion or extension of the entire length of the body while others involve movement of only one or more segments. Some of the tests are static in nature requiring
the ability to hold a stretched position while others are
dynamic and require the ability to make rapid, repeated
movements (8). Many researchers have developed composite
flexibility tests.

Cureton's battery of four tests is one of the earliest
composite measures of flexibility devised (3). It consists
of trunk flexion, trunk extension, shoulder elevation, and
ankle flexibility. Respective test-retest reliability
coefficients of .958, .715, .850, and .728 were obtained.

The Kraus-Weber test battery of minimum muscular fit-
ness includes a pass-fail flexibility item for touching the
toes (15). Buxton (2) extends this test by adding a bench
to obtain more discrimination in scoring. Wells and
Dillon (42) developed a dynamic sit-and-reach test to
eliminate the fear factor associated with a standing test.
A reliability coefficient of .98 was obtained by Wells and
Dillon.

Fleischman (5) developed six tests of dynamic and
extent flexibility in preparation for a factor analysis.
Tests for dynamic flexibility included the squat-twist-
and-touch, bend-twist-and-touch, and the lateral bend.
Tests for extent flexibility included the abdominal stretch,
toe-touching, and twist-and-touch. The first three are
scored by the number of repetitions performed in a given
time period and the second group is measured in inches.
Scott and French (3) devised two tests, one static and one dynamic, to measure extension in the upper back. They also developed three tests for measuring shoulder flexibility. In addition, McCloy and Young (37) developed a test of shoulder flexibility called sideward and backward moving of the arms.

Holland (10) stated that most composite flexibility tests, such as those described above, are "either grossly subjective in nature or involve the use of linear measurement" (p. 54). Leighton (18) has pointed out that gross geometric errors are inherent when using linear assessment of rotational dimensions. Because of these factors, Holland (10) notes that composite tests are not recommended for use in experimental studies or for gathering normative data.

Specificity of Flexibility

Harris (7) conducted a study which investigated the structure of certain measures of flexibility by factor analysis. Forty-two joint action measures of flexibility using Leighton's techniques and thirteen various composite measures were obtained on 147 college age women from the University of Wisconsin. The final analysis yielded fourteen common factors judged to be comparable over the nine derived factors. Of the factors one is an anthropometric factor, one is a speed of repeated movements of body parts factor, eight are joint action type of flexibility factors,
and three are a combination of composite and joint action factors. Harris concluded that there is no evidence that flexibility exists as a single general characteristic of the human body, thus no single joint action measure or composite test can determine the flexibility characteristics of an individual.

Cureton (3) also reported that flexibility is not a general quality of the body. He intercorrelated the results of his four composite flexibility tests and noted that the major joints each have specific conditions for flexibility.

Hupprich and Sigerseth (11) on the basis of data collected on 300 girls, concluded that there is nothing that can be designated as general flexibility, but that conditions governing flexibility are unique to each joint. Leighton (24) following a series of flexibility studies on young boys and championship athletes, agreed that it cannot be determined whether an individual is generally flexible except in reference to specific joints.

Relationship of Flexibility to Physical Aspects

Normative data on measures of human flexibility have been somewhat limited in number and have been collected in studies using many different testing procedures. This has made it difficult to generalize about flexibility (8).
Relationships between flexibility and such factors as age and sex, body build, and physical activity and skill level will be discussed.

Several elementary age students have been tested using the Kraus-Weber test battery. The subjects tested included 1057 Iowa children by Buxton (2), 1195 Oregon children by Kirchner and Glines (14), and 1456 Indiana children by Phillips and others (30). The three studies seemed to indicate that a larger percentage of girls at all ages (six to fifteen) could pass the toe touch test than boys of the same ages. Furthermore, the percentage of boys and girls passing the test showed a gradual decrease from ages six to twelve followed by an increase to age fifteen.

Kendall and Kendall (13) also administered the toe touch test as well as the forehead to knees from the long-sitting position flexibility test to 4500 children from kindergarten through high school. They found a sharp decline from ages six to age twelve in percentage of children passing the toe touch test and then a gradual increase from the age of thirteen to the age of seventeen. Only a small percentage could touch their foreheads to their knees and they showed little change through age seventeen.

Hupprich and Sigerseth (11) obtained twelve flexibility measures on 300 girls ages six to eighteen using Leighton's techniques. An increase in flexibility for nine measures was observed for girls age six to age twelve.
followed by a decline. Gradual decreases in shoulder, knee, and hip (thigh) flexion were observed from ages six to eighteen. The researchers concluded that flexibility is a function of specific factors and not a general factor. Also, certain areas of girls' bodies, for the most part, become progressively more flexible from childhood to adolescence and progressively less flexible after adolescence.

Several researchers have studied the relationship between body build and flexibility. Tyrance (38) collected data on 105 of the "fattest, thinnest, and most muscular" male students at Penn State University using Leighton's techniques. The subjects ranged in age from eighteen to twenty-two. He found very few significant relationships when correlating the measures with the three body types.

Mathews and others (25, 26) obtained flexibility and anthropometric data on two samples. The first group consisted of sixty-six college age women who were measured on three hip flexibility tests. The second group consisted of 158 elementary age males measured on two hip flexibility tests. In both cases, no significant relationship was found between trunk or limb length and flexibility of the hip joint.

Findings of Broer and Galles (1) are not in complete agreement with Mathews' work. They collected data on 100
female college students ages eighteen to thirty-one who were enrolled in physical education classes. Four anthropometric measures were taken, a toe touch test was administered, and hip and lower back flexibility were measured by the Leighton technique. The researchers concluded that the relationship of trunk-plus-arm length to leg length is not an important factor in the performance of the toe touch tests for persons of average build. However, it becomes a significant factor for persons with extreme body builds. They also found no significant relationship between the toe touch test and height.

Wear (39) also found significant correlations for persons with extreme trunk-plus-arm length to leg length ratio. However, he found that prone and supine back extensions were not significantly correlated with trunk length. His data were obtained from 116 college age men from nineteen to twenty-four and consisted of three flexibility and four anthropometric measures.

Laubach and McConville (16) found a general lack of relationship between trunk and hip flexion-extension and somatotypes in forty-five adult males. Leighton's techniques were used for the flexibility measure. In a second study, the same investigators (17) found correlations between sixty-three anthropometric variables, including somatotype, and fourteen of Leighton's flexibility measures.
to be low and mostly insignificant. Data was obtained on sixth-three Antioch College males aged sixteen to twenty-five.

Observations on women have revealed findings similar to those obtained on male subjects. Garrity (6) studied the relationship of flexibility and somatotype in women. The subjects were 202 college age women who were measured on a toe touch test. No significant correlation was found between the two variables.

Using Leighton's techniques, McCue (28) found few significant relationships with overweight and underweight subjects and flexibility. Her measurements were taken on 130 college women ranging in age from seventeen to twenty-six.

Another relationship which has been studied is that of physical activity and skill level upon flexibility. Leighton (21, 22) reported two studies involving males aged six to eighteen in which the six to ten year olds showed little change in flexibility. However, the boys from ten to eighteen showed a steady downward trend in the range of motion of fifteen of eighteen joint measurements. Leighton suggested that the changes reflected the characteristics of movement patterns rather than age level characteristics.

Leighton (19, 22), using his flexometer, studied flexibility of top-level performers in seven sports. The subjects included one hundred college basketball players,
one hundred college baseball players, fifty college swimmers, forty-four college shot putters and discus throwers, five champion weight lifters ages twenty-five to forty-six, eleven gymnasts who were members of the 1953 national collegiate gymnastics team and nine wrestlers who were members of the 1953 national collegiate championship team. Leighton concluded that the number and kind of specialized flexibility performance abilities vary significantly among the specialized skills studied. Furthermore, these variations do not occur for all movements nor for the same movements among the different groups.

Sigerseth and Haliski (34) obtained twenty-one flexibility measures using the Leighton flexometer on one hundred experienced football players from the University of Oregon. When the investigators compared the data with that collected by Leighton on fifty-six college males enrolled in physical education classes (23), they found the students to be more flexible than the football players in thirteen of twenty-one joints or areas. The football players were more flexible only in side trunk flexion. No significant difference was found between the football linemen and backs.

In studying flexibility characteristics of women, McCue (28) found no significant differences between physical education majors and non-majors. McCue's data was obtained on 130 college age women. It consisted of five of Leighton's measures and seven of the researcher's own tests. Other
findings were that those individuals who had a past history of more activity tended to be more flexible than those of less activity. Furthermore, on the lower quartile flexibility group of this study, a significant increase in flexibility was achieved with mild exercise within a period of three weeks for five measures. The increase was still evidenced in three of five measures eight weeks following cessation of the exercise program.

Summary

A review of the literature revealed limited research in the area of aerobic dance. The relationship of aerobic dance to energy cost, cardiovascular endurance, and several psychosocial effects has been researched but the literature revealed no studies involving aerobic dance and flexibility. There are basically two types of flexibility, static and dynamic, which are measured as either single joint action or composite action. Instruments and techniques of flexibility measurement include manual goniometers, electrogoniometers, the Leighton flexometer, and several field tests requiring little or no equipment. The Leighton flexometer appears to be the instrument of choice for flexibility measurements.

Several investigators have concluded that flexibility does not exist as a single general trait and cannot be determined by a single measurement. Past activity participation seems to influence specific flexibility patterns within an individual. Furthermore, sex and age have been
found to correlate significantly with flexibility. Females appear to be more flexible than males and there is a decline in flexibility that occurs with increasing age. However; there is only minimal evidence that there is not a zero correlation between body build and flexibility.


CHAPTER III

PROCEDURES

A review of the literature in the areas of aerobic dance, the nature of flexibility, measurement of flexibility, specificity of flexibility, and the relationship of flexibility to various physical aspects was conducted. The review was utilized in the present investigation to determine whether or not aerobic dance sessions performed with Jacki Sorensen's stretching program would result in increased flexibility or whether an alternate program of stretching would be more beneficial. No confirming or disconfirming literature was found regarding this research problem. Subsequently, an experimental condition was developed to explore this problem.

Subjects

The subjects for this study were

1. Forty-seven women enrolled in three aerobic dance classes at North Texas State University, Denton, Texas, during the spring semester, 1978,

2. Sixteen women selected from bowling and archery classes offered at North Texas State University, Denton, Texas, during the spring semester, 1978.

All subjects were required to meet the following criteria to be included in the study:
1. No previous experience in aerobic dance;
2. No medical limitations for aerobic activities as noted by Dr. Ken Cooper (1, pp. 49-50);
3. No subject could weigh more than thirty pounds over the recommended weight (9, p. 55) for safe participation in an aerobics program (see Appendix A);
4. No known limitation of joint movement due to either injury or pathological reasons.

The first criteria was required to minimize the effects of past aerobic dance activity on flexibility. Criteria two and three were included as safety factors while the final criterion was designed to eliminate the effects of joint disorder on flexibility.

Experimental Design

Permission for the use of the subjects was obtained from the Acting Chairperson of the Division of Physical Education and the Coordinator of the Physical Education Activity Program at North Texas State University. Furthermore, each subject was required to sign a certification of informed consent and subject information (see Appendix B).

The subjects for the study enrolled in classes which were left intact in an incidental sampling of three aerobic dance classes (experimental) and one bowling and one archery class (controls). Subjects attended physical education classes that met three times a week on Monday, Wednesday, and Friday for fifty minutes per session. Each session
consisted of a five minute dressing period, a five minute stretching series, three minutes of rhythmic sit-ups, a five minute warm-up routine, twenty to twenty-five minutes of vigorous aerobic routines, a three minute cool down routine, five minutes of cool down stretches, and five minutes for dressing period. The exception to this schedule occurred for the no stretch group who had ten minute dressing periods and no stretching time.

The warm-up routine was choreographed to begin at a slow pace and allow stretching of the body's large muscles. It gradually increased in intensity until the conclusion when the dancers performed at a jog-run level (9, 10). The cool down routine was used as a recovery period during which the routine was slow to allow the heart rate to return to normal (9, 10). The stretches involved in these routines served as the only warm-up and cool down stretches for experimental group I(NS).

The routines and stretching exercises were taught by a 'qualified' aerobic dance instructor. All routines taught were from Jacki Sorensen's repertoire of Texas public school dances. A Sony cassette player was used during the dance sessions. All routines were pre-recorded on cassette tapes. The instructor performed each routine with the class as well as verbalized cues of the dance steps. The students performed the routines in either a random scattering or a large circle around the perimeter of the room. Occasionally, the
instructor asked students to rearrange their floor order so that all students would have an opportunity to dance in an area which allowed optimal vision of the instructor.

The total experimental period consisted of eleven weeks. The first week contained verbal orientation. The second and third weeks involved recording of various anthropometric measures and a period of orientation to aerobic dance during which some basic skill was achieved (9). The remaining weeks consisted of following a daily routine of rhythmic sit-ups and selected aerobic dances. The same dance routines were performed in the three classes each week. A log was kept in which were recorded routines performed daily and any departures from the regular protocol (see Appendix G). A one week vacation occurred between the eighth and ninth weeks. A one day holiday occurred at the end of the ninth week. Flexibility measures were taken during the third and eleventh weeks. Any subjects who missed more than three class periods were eliminated from the study. This resulted in the elimination of seventeen subjects. Three students were eliminated as subjects due to joint injuries sustained during the experimental period.

Test Instrument

After reviewing the literature, the Leighton flexometer was selected as the tool which best measures flexibility of human joints for the following reasons.
1. It appears to be the most objective for measuring joint action (4).
2. It takes measurements in units universal to all movements (6).
3. The measures are free from effects or variation in length and breadth of body segments (7).
4. It is applicable to measuring actions of all segments (7).
5. Its original reliability coefficients range from .889 to .997 for various measurements (7).

Test Administration

All testing was conducted in the Human Performance Laboratory in the Women's Gym, North Texas State University, Denton, Texas. The investigator administered all tests and recorded the scores. The subjects were instructed to wear a comfortable top and shorts.

Upon arrival in the laboratory each subject read the certification of informed consent. Any questions were answered and the subject's signature was obtained. The subject's name, age in months, height, and weight were then recorded on the score sheet (see Appendix E). No warm-up was allowed prior to collection of data. Two trials of eight tests were administered to each subject. Prior to each test, the administrator read instructions to the subjects (see Appendix F for instructions for all test items).
The eight tests were selected based upon the findings of Harris' (2, 3) factor analytic study of flexibility which resulted in fourteen factors. Of Harris' fourteen factors, one was an anthropometric factor, one was a speed of repeated movements of body parts factor, one was a composite flexibility factor, eight were joint action flexibility factors, and three were combination composite and joint action flexibility factors. It should be noted that Holland (4) recommended that composite tests of flexibility not be used in experimental studies. Therefore, those factors which were either a composite type of flexibility factor or a combination of composite and joint action flexibility factor, as found by Harris, were not used in the current investigation. Also, the anthropometric factor and the speed of repeated movements of body parts factor were deemed irrelevant to this study and were not included.

For the eight factors selected from Harris' (2, 3) study, the variable which consistently "loaded" the highest under each factor across the nine derived solutions was included in this study. The items tested with respective correlation coefficients reported by Harris (2) were:

1. Hip flexion center (.977)
2. Knee flexion-extension (.997)
3. Ankle extension (.956)
4. Shoulder abduction-adduction (.980)
5. Neck rotation (.973)
6. Hip lateral rotation (.963)
7. Wrist extension (.982)
8. Spine lateral flexion (.977)

The tests were conducted using Leighton's (6) techniques as modified by Harris (2). For those variables involving movement to only one side or of just one body extremity, the right side or extremity was measured. The order of tests was performed randomly for each subject. The order was established by means of a table of random numbers (5).

The procedure described for test administration was repeated during the eleventh week. An attempt was made to take the final set of measures at the same hour on the same weekday as the first set of measures was taken. However, the final measures were taken only once and the informed consent was not signed again.

Analysis of Data

Reliability was established on the eight test items by means of the Pearson Product Moment Correlation (5). Data obtained during the third week of the experimental period was used for the reliability coefficients. A factor analysis was also performed to confirm similar factor structure and validate the use of the selected item.

Finally, the data were treated by the use of eight one-way analyses of covariance (5). The covariates were age and pretest scores. These variables were removed to statistically control any bias that age and initial level of flexibility might have upon the results of the study and to equate initial differences between the intact groups. The dependent
variables were the range of motion scores which were obtained from the eight flexibility tests. The $F$ ratio was used to determine if a significant difference existed between the three experimental groups and between the control group and any of the experimental groups. Follow-up comparisons were made by the use of the Tukey HSD method. A comparison between the NTSU group and Jacki Sorensen groups on hip flexion was made by use of the Scheffe' method to provide more stringent requirements. In this study, the .01 level of significance was utilized because the number of analyses would increase the probability of rejecting a Null hypothesis by chance alone (Type I error).
CHAPTER BIBLIOGRAPHY


CHAPTER IV

PRESENTATION OF THE DATA

It was the purpose of this study to investigate the possible chronic alterations in joint flexibility associated with aerobic dance instruction of college age females. Data collected on sixty-three college females included age, height, weight, and pre- and posttest scores for hip flexion, knee flexion-extension, ankle extension, shoulder abduction-adduction, neck rotation, hip lateral rotation, wrist extension, and spine lateral flexion. The raw data collected during the study are contained in Appendix H. The mean height of the subjects was $64.79 \pm 7.76$ inches, the mean weight was $127.65 \pm 21.87$ pounds, and the mean age was $21.30 \pm 2.93$ years. Data analysis included a factor analysis to confirm the validity of the flexibility measures, a regression analysis to confirm the reliability of the procedures, and eight analyses of covariance to determine the degree of flexibility gains associated with the treatment period.

Validity and Reliability of Instruments

The results of the validity and reliability analyses are revealed in Tables I and II. Table I contains the correlation coefficients of the eight flexibility measures
<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>1</td>
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<td>0.3472</td>
<td>0.1234</td>
<td>0.1346</td>
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<td>0.0554</td>
<td>0.3242</td>
<td>0.3503</td>
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<td>2</td>
<td>1.0000</td>
<td>-0.0857</td>
<td>0.3660</td>
<td>0.2653</td>
<td>0.0860</td>
<td>0.3758</td>
<td>0.3244</td>
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<td>3</td>
<td>1.0000</td>
<td>0.1568</td>
<td>-0.0651</td>
<td>0.0660</td>
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<td>0.1023</td>
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<td>4</td>
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<tr>
<td>6</td>
<td>1.0000</td>
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<td>1.0000</td>
<td>0.1915</td>
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<tr>
<td>8</td>
<td>1.0000</td>
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<td></td>
<td></td>
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</tbody>
</table>
TABLE II
PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS OF EIGHT FLEXIBILITY FACTORS RESULTING FROM TEST-RETEST MEASUREMENTS FOR RELIABILITY DETERMINATIONS

<table>
<thead>
<tr>
<th>Test Item</th>
<th>Correlation Coefficient</th>
<th>Test Item</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion</td>
<td>0.9544</td>
<td>Neck rotation</td>
<td>0.9191</td>
</tr>
<tr>
<td>Knee flexion-extension</td>
<td>0.9495</td>
<td>Hip lateral rotation</td>
<td>0.9657</td>
</tr>
<tr>
<td>Ankle extension</td>
<td>0.9213</td>
<td>Wrist extension</td>
<td>0.9454</td>
</tr>
<tr>
<td>Shoulder abduction-adduction</td>
<td>0.9475</td>
<td>Spine lateral flexion</td>
<td>0.9392</td>
</tr>
</tbody>
</table>

which were obtained through factor analysis. The correlations ranged from .0227 between hip flexion and neck rotation to .3503 between knee flexion-extension and wrist extension. The findings confirmed the independence and subsequent validity of the selected flexibility measures.

Table II reveals the results of the Pearson Product Moment Correlation between the two pre-test trials for each of the eight selected flexibility measures. The scores ranged from .9191 for neck rotation to .9657 for hip lateral rotation, indicating high reliability for the procedures which were performed.

Analysis of Flexibility Gains

The final analysis consisted of eight analyses of covariance for the selected flexibility measures which were
used to determine if chronic flexibility would increase in aerobic dancers. Figures 1 through 3 and Tables III through VIII reveal results of the covariance.

Hip flexion, as revealed in Figure 1, resulted in mean gains of 5.8462 degrees for experimental group I, 19.4375 degrees for experimental group II, 18.1111 degrees for experimental group III, and no mean gain for control group IV. Further analysis of the hip flexion measurement, as shown in Table III, resulted in an F-ratio of 12.80 which was significant beyond the .0001 level of confidence. A value of 4.16 was necessary for significance at the desired .01 level. Table IV reveals the subsequent comparison between means by the Tukey HSD (5).

For significance to be reached at the .01 level in the Tukey HSD test, a value of 4.16 was needed. Application of the Tukey comparison among adjusted group means revealed a significant difference between the NTSU and control groups, the Jacki Sorensen and control groups, and the NTSU and no stretch groups. Further comparison between the NTSU and Jacki Sorensen groups by the Scheffe method of comparison revealed a ratio of 1.30. However, a value of 12.48 was needed for significance at the .01 level.

Figure 2 depicts the group means for ankle extension. Mean gains shown were 4.1439 degrees for group I, 8.1875 degrees for group II, and 4.2222 degrees for group III. Control group IV showed a mean loss of 3.1825 degrees. The analysis of covariance for ankle extension, as revealed
Figure 1 - Descriptive Statistics on Hip Flexion Changes from Pretest (T₁) to Posttest (T₂)

Group I (n=13)
Group II (n=16)
Group III (n=18)
Group IV (n=16)
TABLE III
ANALYSIS OF COVARIANCE AND ADJUSTED MEANS FOR HIP FLEXION

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
<th>Adjusted Group Means</th>
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</thead>
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<td>1207.78</td>
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<td>.0000</td>
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<td></td>
<td></td>
<td>II-118.57</td>
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<tr>
<td>Within</td>
<td>5378.02</td>
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<td>94.35</td>
<td></td>
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<td>III-114.75</td>
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<td></td>
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<td>IV- 99.53</td>
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<tr>
<td>Total</td>
<td>9001.36</td>
<td>60</td>
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</tr>
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</table>

* Value of 4.16 is necessary for significance at .01 level of confidence.

TABLE IV
COMPARISON OF GROUP MEANS USING THE TUKEY HSD METHOD FOR HIP FLEXION

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (No stretch)</td>
<td>0.0000</td>
<td>-5.4226*</td>
<td>-3.9079</td>
<td>2.1348</td>
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<tr>
<td>Group II (NTSU)</td>
<td>0.0000</td>
<td>1.5147</td>
<td>7.5575*</td>
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</tr>
<tr>
<td>Group III (Jacki Sorensen)</td>
<td>0.0000</td>
<td>6.0428*</td>
<td></td>
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<tr>
<td>Group IV (Control)</td>
<td>0.0000</td>
<td></td>
<td></td>
<td></td>
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</table>

* Value of 4.16 is necessary for significance at the .01 level of confidence.
Figure 2 - Descriptive Statistics on Ankle Extension Changes from Pretest ($T_1$) to Posttest ($T_2$)
in Table V, resulted in an F-ratio of 3.272. The ratio was significant at the .0276 level; however, it did not reach the specified level of significance. Table VI reveals the subsequent Tukey comparison between adjusted group means.

Group means for spine lateral flexion are shown in Figure 3 while the adjusted group means and the analysis of covariance for the same measure are included in Table VII. Figure 3 reveals mean gains of 3.445 degrees, 3.1358 degrees, 8.3125 degrees and 0.7500 degrees for groups I, II, III, and IV respectively. The analysis of covariance for spine lateral flexion in Table VII revealed an F-ratio of 3.6904 which did not reach the desired .01 level of significance. However, it did reach the .0169 probability level. Comparisons between the adjusted group means by Tukey's HSD method are shown in Table VIII. An F-ratio of 4.3836 was found for group II in spine lateral flexion. However, there was failure to reject the null hypothesis due to the small sample size.

Discussion of the Findings

In the present investigation, two pre-test trials and one posttest trial of eight flexibility measures were obtained. A factor analysis was completed on the posttest scores and revealed low correlation coefficients between the means of eight measures. This finding confirms the independence of the measures and supports the work of
TABLE V
ANALYSIS OF COVARIANCE AND ADJUSTED GROUP MEANS
FOR ANKLE EXTENSION

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P</th>
<th>Adjusted Group Means</th>
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<tbody>
<tr>
<td>Between</td>
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<td>I-61.74</td>
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<td></td>
<td>II-68.18</td>
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<tr>
<td>Within</td>
<td>3518.44</td>
<td>57</td>
<td>61.7270</td>
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<td></td>
<td>III-62.77</td>
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<tr>
<td>Total</td>
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<td></td>
<td></td>
<td></td>
<td>IV-59.60</td>
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</table>

Value of 4.16 is necessary for significance at .01 level of significance.

TABLE VI
COMPARISON OF GROUP MEANS USING THE TUKEY METHOD FOR ANKLE EXTENSION

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
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<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (No stretch)</td>
<td>0.0000</td>
<td>-3.0960</td>
<td>-0.4957</td>
<td>1.0286</td>
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<tr>
<td>Group II (NTSU)</td>
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<td>0.0000</td>
<td>2.6003</td>
<td>4.1246</td>
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<td>Group III (Jacki Sorensen)</td>
<td>0.4957</td>
<td>-2.6003</td>
<td>0.0000</td>
<td>1.5243</td>
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<tr>
<td>Group IV (Control)</td>
<td>-1.0286</td>
<td>-4.1246</td>
<td>-1.5243</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Value of 4.16 necessary for significance at .01 level
Figure 3- Descriptive Statistics on Spine Lateral Flexion Changes from Pretest ($T_1$) to Posttest ($T_2$)
### TABLE VII

**ANALYSIS OF COVARIANCE AND ADJUSTED GROUP MEANS**  
**FOR SPINE LATERAL FLEXION**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
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<th>MS</th>
<th>F</th>
<th>P</th>
<th>Adjusted Group Means</th>
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<tr>
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<td>0.0169</td>
<td>I-60.01</td>
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<tr>
<td>Within</td>
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<td>57</td>
<td>29.82</td>
<td></td>
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<td>II-64.20</td>
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<td></td>
<td></td>
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<td>III-62.02</td>
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<td>IV-57.96</td>
</tr>
</tbody>
</table>

Value of 4.16 necessary for significance at .01 level of significance.

### TABLE VIII

**COMPARISON OF GROUP MEANS USING THE TUKEY METHOD FOR SPINE LATERAL FLEXION**

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
<th>Group IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (No stretch)</td>
<td>0.0000</td>
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<td>-1.4050</td>
<td>1.4430</td>
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<tr>
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<td>1.5356</td>
<td>4.3836</td>
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</tr>
<tr>
<td>Group III (Jacki Sorensen)</td>
<td>0.0000</td>
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<td>4.3836</td>
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</tr>
<tr>
<td>Group IV (Control)</td>
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<td>0.0000</td>
<td>2.8480</td>
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</tr>
</tbody>
</table>

Value of 4.16 needed for significance at .01 level of significance.
Harris (3, 4) in which a factor analysis performed on fifty-five flexibility and anthropometric measures resulted in fourteen common factors. Of Harris' fourteen factors, the eight which consisted only of joint action measures were used in the current investigation. Resulting correlation coefficients ranged from .0227 to .3503. These values indicated low correlation between the flexibility tests. The presence of these low coefficients appears to justify statements by Cureton (1), Hupprich and Sigerseth (5), and Leighton (13) that flexibility is not a general characteristic but is joint specific. Further, it supports Harris' (4) belief that no single joint action measure or composite test can determine an individual's flexibility characteristics.

The two pre-test trials obtained for each of the eight tests performed were used to compute the Pearson Product Moment Correlation. All eight resulting correlations were high, the lowest being .9191 for neck rotation. This finding supports the work of several past researchers, in particular, that of Leighton (12), whose original reliability estimates ranged from .889 to .997 for test-retest of two trials. Others who reported very high correlation coefficients include Hupprich and Sigerseth (5), Leighton (8), and Laubach and McConville (7). The results of the correlations suggest that both the instrument and the technique used are highly reliable.
A final finding concerned differences between the four groups on the flexibility measures. Two groups of subjects included ten minutes of stretching exercises in addition to the regular cardiovascular workout associated with aerobic dance class. Of these two groups, one performed stretches recommended by Jacki Sorensen while the other group performed stretches included in the NTSU Stretch and Flexibility Program. A third group omitted the stretches while the fourth group consisted of control subjects. Analysis of covariance revealed the two stretching groups to be significantly greater in hip flexion than the control group, and the NTSU group to be significantly greater in hip flexion than the non-stretching group. However, there was no difference between the stretching groups on hip flexion. In each of the seven other tests, including knee flexion-extension, ankle extension, shoulder abduction-adduction, neck rotation, hip lateral rotation, wrist extension, and spine lateral flexion, no differences existed among the four groups following a period of aerobic dance instruction.

McCue (15) had previously reported a significant increase in flexibility of five movements of the lower quartile of a group of one hundred thirty college women following a three week period of mild, common exercises which were performed daily for an unspecified length of time. In the present study, exercises were performed at a frequency of three times per week for a duration of only ten minutes. Mathew and Fox (14) have suggested that the frequency and
duration of a static flexibility program should be a minimum of two days per week for a period of thirty minutes with each position to be held for a minimum of thirty seconds. The shortened duration of stretching used in the current study is one possible explanation for the lack of difference between the groups for seven of the measurements. Also, the present investigation utilized a stretch of about ten seconds in length as opposed to the recommended thirty second time period. deVries (2) has stated that the use of a long sustained stretch would tend to eliminate the phasic (jerky) component of the stretch reflex to be of sufficient force to reach the threshold of the tendon organs or flower spray endings thus initiating the inverse myotatic reflex which will inhibit the muscle under stretch and thus further aid in stretching the muscle.

Mathews and Fox (14) commented that all training programs must be specific to the system in use. By carrying this principle further, one may note that training for flexibility must be joint specific. Harris (3, 4) and Leighton (13), among others, reported that flexibility is not a general quality or characteristic of the body. Thus, a great deal of flexibility in one region of the body does not necessarily insure that condition in other body regions. Research by Leighton (9, 11) bears this out. In studies involving championship athletes, the researcher concluded that the number and kind of specialized flexibility performance abilities vary significantly among the specialized
skills studied and furthermore, the variations did not occur for all movements nor for the same movements among the different movements among the different groups. Also, the same researcher found a steady downward trend in several joint measurements of boys ages ten to eighteen which he felt to be a reflection of the characteristics of movement patterns (10).

By inspecting the stretching exercises performed by the experimental groups, one finds that different movement patterns were performed by the groups in the warm-up and cool down. Group one performed no stretches other than those included in the routines. The NTSU group performed several exercises involving hip flexion stretches. All three experimental groups did perform the rhythmic sit-up routine which was designed to enhance hamstring flexibility thereby permitting greater hip flexion. Both of the stretching groups performed a small amount of ankle stretching. All three groups performed sidebends (which involve spine lateral flexion) in the warm-up routine but only the Sorensen group performed additional sidebends in the warm-up period. The means for ankle extension and spine lateral flexion did increase; however, the differences between groups did not reach significance.

A third possibility for the lack of difference between the group means is based upon the overload principle (13) which implies that to increase fitness, exercise resistance must be maximal and must gradually increase as fitness
capacity improves. Thus, for flexibility to increase, the exercises must be performed at maximal stretch. It is highly possible that not all subjects performed maximally thereby altering the final results.

Summary of Findings

The present investigation resulted in three major findings. Low interfactor correlation coefficients obtained from a factor analysis of eight flexibility measures confirmed the validity of the selected tests. Also, high coefficients secured from the Pearson Product Moment Correlation confirmed the high reliability of the selected factors. Finally, a difference was found in hip flexion between the stretching groups as opposed to the non-stretching and control groups. No differences were found between the NTSU and Jacki Sorensen groups. No significant differences were found between the groups on the remaining seven variables.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this investigation was to determine if chronic changes in flexibility would occur following an eleven week aerobic dance instructional period.

The experiment consisted of a four by two factorial design which utilized sixty-three informed, consenting, college women. The subjects enrolled in classes which were left intact in an incidental sampling of three aerobic dance classes (experimental groups) and a bowling class and archery class (control group). Group I (n=13) performed aerobic dance using only the routines to provide stretching. Group II (n=16) performed a modified version of the NTSU Stretch and Flexibility Program for ten minutes in addition to the aerobic routines. Group III (n=18) performed the Jacki Sorensen-designed stretches for ten minutes in addition to the aerobic routines and Group IV (n=16) served as the control group.

A factor analysis was performed on the posttest mean scores to confirm validity of the selected measures. The Pearson Product Moment Correlation served to determine reliability for each of the eight measures. Finally, eight
analyses of covariance were used to determine significant differences among the groups' performances on the eight flexibility tests. Alpha was set at the .01 level.

Results

The following are the results of the present investigation.

1. The subjects in the NTSU and Jacki Sorensen groups showed improvement in hip flexion after eleven weeks of training.

2. There was an equal increase in hip flexion for the NTSU and Jacki Sorensen groups.

3. Changes in knee flexion-extension, ankle extension, shoulder abduction-adduction, neck rotation, hip lateral rotation, wrist extension, and spine lateral flexion did not occur following eleven weeks of aerobic dance training that utilized selected flexibility programs.

4. A program of aerobic dance combined with a series of flexibility exercises as warm-up and cool down can be beneficial in increasing the hip flexion of college women.

5. A modified version of the NTSU Stretch and Flexibility Program is just as beneficial as the Jacki Sorensen stretching program for increasing hip flexion in college women.
Conclusions

Concerning the effects of an eleven week program of aerobic dance training, the following conclusions would seem warranted.

1. A program of aerobic dance alone is not sufficient to promote flexibility.
2. The factor analysis confirms the specificity of flexibility in reference to individual joints.
3. The Leighton flexometer provides highly reliable estimates of joint flexibility.
4. Supplemental flexibility activities of ten minutes duration used in conjunction with aerobic dance training are beneficial in increasing hip flexion.
5. Either greater intensity, duration, or frequency of exercise or different flexibility activities are required to elicit chronic flexibility gains during aerobic dance instruction.

Recommendations

The following recommendations are offered.

1. Different age groups should be used as subjects to determine the effects of aerobic dance training and age upon flexibility.
2. A similar study should be performed on participants in the commercial aerobic dance program.
3. A similar study should be performed using two days per week and five days per week as the training frequencies.

4. A similar study should be conducted over a period of three months to one year.
APPENDIX A

DESIRED WEIGHT CHART

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
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<td>100-110</td>
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<td>103-115</td>
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<tr>
<td>5'4&quot;</td>
<td>108-120</td>
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<tr>
<td>5'5&quot;</td>
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APPENDIX B

CERTIFICATION OF INFORMED CONSENT
AND SUBJECT INFORMATION

I have been informed of the research program at North Texas State University involving a study of flexibility and aerobic dance.

I understand the nature and purpose of the study and also am aware that I may withdraw my consent for my status. With my understanding of this and having received this information and satisfactory answers to any questions asked, I voluntarily consent to participate in the study described.

I can also truthfully answer the following questions:

1. I have never participated in an aerobic dance class.
   _____ Yes _____ No

2. To my knowledge, I have no medical limitations for participation in aerobic activities. _____ Yes _____ No

3. With regard to height and weight, I am within the range of no more than thirty pounds over the desired body weight for my height. _____ Yes _____ No

4. I have no known limitation of joint movement due to injury or pathological reasons. _____ Yes _____ No

Signed ___________________________ Date ________________
APPENDIX C

JACKI SORESEN'S STRETCH PROGRAM

POSITION 1 - STRAIGHT STANDING
a. ankle circles
b. lower leg circles
c. lower back twists
d. half kneebends
e. single shoulder rolls
f. double shoulder rolls
g. knee pull right and hold
h. knee pull left and hold

POSITION 2 - SIDE STRADDLE STANDING
a. sidebends right
b. sidebends left
c. floorsweep center
d. floorsweep right
e. floorsweep left

POSITION 3 - FORWARD-BACKWARD STRIDE
a. calf stretch right standing
b. calf stretch left standing
c. calf stretch right bent at waist
d. calf stretch left bent at waist
APPENDIX D

NTSU STRETCH AND FLEXIBILITY PROGRAM
MODIFIED VERSION

POSITION 1 - STRADDLE STANDING

a. Rotate neck
b. Rotate, flex, and extend wrists
c. Flex and extend elbows
d. Rotate arms in variety of circular patterns
e. Rotate trunk
f. Reach right and hold
g. Reach left and hold
h. Reach center and hold

POSITION 2 - STRAIGHT STANDING

a. Reach to bent stand and hold

POSITION 3 - STRAIGHT SITTING

a. Stretch toes
b. Rotate, flex, and extend ankles
c. Bent sitting and hold
d. Groin tuck and hold

POSITION 4 - STRADDLE SITTING

a. Reach right and hold
b. Reach left and hold
c. Reach middle and hold
d. Hurdler's stretch right and hold
e. Lie back in above position
f. Hurdler's stretch left and hold
g. Lie back in above position

POSITION 5 - STRAIGHT LYING

a. Right leg lift and hold
b. Left leg lift and hold
c. Double leg lift to pike and hold
d. From pike, straddle and hold
## APPENDIX E

### SCORE SHEET

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APPENDIX F

INSTRUCTIONS FOR FLEXIBILITY TESTS

1. Hip Flexion (center)

   Position: Standing, feet together, knees straight, arms extended above head, hands clasped with palms up.

   Instrument: Right side of hip at height of umbilicus.

   Flexion: Bend forward as far as possible. Reading taken.

   Caution: Knees must be kept straight. Toes and heels may not be raised from floor. Feet may not be shuffled.

2. Knee Flexion-Extension

   Position: Prone-lying on table with knees at end of and lower legs extending beyond end of table. Right lower leg parallel to floor.

   Instrument: Outside of right ankle.

   Flexion-Extension: Foot moved upward and backward in an arc to position as near buttocks as possible. Reading taken.

   Caution: Position of upper leg may not be changed during movement. Tester holds upper leg down during extension.

3. Ankle Extension

   Position: Sitting on table with right leg resting on and foot projecting over end of table, knee straight, left leg flexed, foot resting on table. Sole of right foot is perpendicular to floor.

   Instrument: Inside of right foot.

   Extension: Foot turned downward as far as possible. Reading taken.

   Caution: Knee of right leg must be kept straight throughout movement. No sideward turning of the foot is allowed.
4. Shoulder Abduction-Adduction

Position: Standing with arms at sides, left side to wall, shoulder touching wall, left fist doubled with knuckles forward, thumb-side of fist touching hip and other side touching wall, feet together, knees and elbows straight. Right palm against side.

Instrument: Back of right upper arm.

Abduction-Adduction: Palm of right hand pressed against side of leg, reading taken, arm moved sideward, outward and upward in an arc as far as possible, reading taken. Score is total arc moved.

Caution: Left fist must be kept in contact with body and wall. Knees, body and elbows kept straight. Arm raised directly sideward, palm facing down.

5. Neck Rotation

Position: Supine-lying on bench, head and neck projecting over, shoulders touching edge of bench and arms at sides of bench. Subject facing directly upward.

Instrument: Top of head.

Rotation (right): Head turned to right as far as possible. Reading taken.

Caution: Shoulders may not be raised from bench.

6. Hip Lateral Rotation

Position: Sitting on table with right leg resting on and foot projecting over end of table, knee straight, left leg resting on table but pointed to the left. Sole of right foot is perpendicular to floor.

Instrument: Bottom of right foot.

Lateral Rotation: Foot turned outward as far as possible. Reading taken.

Caution: Knee and ankle joints must remain locked throughout movement. Position of hips may not be changed during movement.

7. Wrist Extension

Position: Sitting in armchair, back straight, right forearm resting on chair arm, fingers together and
straight, thumb across palm, palm of right hand facing up. Right hand in line with forearm and extended beyond end of chair arm. Lean on right forearm to stabilize it.

Instrument: Thumb-side of right hand.

Extension: Hand moved downward and backward in an arc as far as possible. Reading taken.

Caution: Forearm may not be raised from chair arm during movement. Hand may not move sideward.

8. Spine Lateral Flexion

Position: Standing, feet together, knees straight, arms at sides, looking straight ahead.

Instrument: Middle of back just below armpit height.

Lateral Flexion (right): Bend sideward to the right as far as possible. Reading taken.

Caution: Both feet must remain on floor, heels may not be raised during measurement. Subject may bend sideward only and must not be allowed to bend backward or forward.
APPENDIX G

The following routines were performed during class meetings. Unless otherwise noted, the same outline was followed for all three classes. In addition, experimental groups two and three performed stretches outlined in Appendices C and D.

January 16
Introductions
General information

January 18
Discussion of aerobics
Learn stretching routines
Learn sit-up routine
Easy Come Easy Go
Stretch out

January 20
No school
Snow

January 23
Check heart rates
Take anthropometric measures

January 25
Sit-ups
Applause (warm-up routine)
Skybird
Easy Come Easy Go

January 27
Sit-ups
Applause
Skybird
Thoroughly Modern Millie

February 1
Sit-ups
Applause
Skybird
Thoroughly Modern Millie
Go Away Little Girl
Freedom

February 3
Sit-ups
Applause
Skybird
Thoroughly Modern Millie
Go Away Little Girl
Freedom

February 6
Sit-ups
Applause
Thoroughly Modern Millie
Go Away Little Girl
The Beat Begins
Freedom
# APPENDIX G CONTINUED

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No class - Spring break

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APPENDIX G CONTINUED

March 29
Sit-ups
Applause
One Toke Over the Line
TSOP
Day by Day
Ragtime Song
Freedom

March 31
Sit-ups
Applause
Skybird
TSOP
Day by Day
Ragtime Song
Hawaii Five-O
Freedom

April 2
Sit-ups
Applause
Rock Around the Clock
TSOP
Hawaii Five-O
Day by Day
One Toke Over the Line
Freedom

April 4
Sit-ups
Applause
Day by Day
Shaggy Bop
The Beat Begins
Rock Around the Clock
Hawaii Five-O
Freedom

April 6
Sit-ups
Applause
Go Away Little Girl
TSOP
Shaggy Bop
Sweet Gypsy Rose
Easy Come Easy Go
Freedom
APPENDIX H

AGE, HEIGHT, WEIGHT, AND FLEXIBILITY
SCORES OF SUBJECTS

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Publications of Learned Organizations


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