The effect of resistance training on some biochemical and physical variables in secondary school female students with thinness

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Introduction and research problem

Ryder (2004) states that resistance training has an effective impact on all biochemical variables, as it activates both blood circulation and biochemical variables, activates the individual's internal systems, and is closely linked to the individual's characteristics, ability, and energy (6: 41) .

Martin Tuma (2019) explains the principles of resistance training as follows:

- The Principle of vector resistance: Increasing resistance by moving the body away from the device's fulcrum and then returning to the fulcrum. The higher the body is from the ground, the easier the performance becomes, and the closer the body is to the ground, the more difficult the performance becomes.
- The Principle of Instability: Performing exercises by relying on one arm or one foot instead of both legs.

Resistance training can be performed by all individuals, regardless of their level of performance or physical fitness, as it can be easily adjusted (4: 23).

The results of the studies of Fleck & Kramer (2004) (3) and Baechle et al. (2000) (1) indicate that resistance training plays a major role in developing various skills. The results of their research show that using the variable resistance training method is very important, as resistance

training is performed in a way that has a specificity to the sporting activity being practiced, which helps in improving the physical abilities specific to the type of activity, as well as improving the level of skill performance of the players, as the motor performance of resistance training is similar to muscular work.

Reed et al. (2015) explain the importance of the secondary stage, especially in acquiring different knowledge, cultures, and scientific rules that crystallize, diversify, and branch out in the university education stage. Therefore, it is necessary to increase attention to this stage, by preparing its educational curricula well according to sound scientific foundations for the development and advancement of students. The secondary stage corresponds to the adolescence stage, and female students at that stage tend to care for themselves, and the health level improves in general, and maturity and control of different abilities increase, and lack of harmony between the different parts of the body may appear as a result of the growth spurt, and the concept of the body greatly affects the psychological health of female students at this stage, which makes them care about health culture and sports, especially those that are very popular among their peers, especially if this student enjoys good health and physical fitness (5:36).

By observing the field of fitness training in many health clubs and by reviewing the researchers' many studies assigned to research on resistance exercises, it was found that there are many studies that dealt with resistance exercises, while no one addressed the impact of these exercises on the level of health fitness and some biochemical and physical variables in the research sample. And to the best of the researchers' knowledge, no study was found that dealt with this in its research circles. Hence, the idea of this research came. In order for the researchers to conduct this study, resistance exercises were included in their research plan instead of traditional exercises in order to achieve the desired goal. Therefore, the researchers chose the research topic entitled: The effect of resistance exercises on some biochemical and physical variables in secondary school students suffering from thinness.

Research objective:

The current research aims to identify the extent of the impact of resistance exercises on each of some:

1. Biochemical variables "hemoglobin, red blood cells, hematocrit, platelets."
2. Physical variables "trunk flexion, grip strength, zigzag running, 5x55m running"

Research hypotheses:

In light of the research objective, the researchers assume the following:

1. There are statistically significant differences between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables in favor of the post-measurement.
2. The improvement rates differ between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables.

Search terms:

Resistance exercises

A type of exercise called suspension exercises that uses body weight against gravity to build strength, balance, coordination, flexibility, and to develop muscular capacity, agility, and strength endurance. It relies on the abdominal, back, and pelvic muscles to perform it using a set of different exercises (2:20).

Research procedures

Research methodology

Given the nature of the research and to achieve its objectives and hypotheses, the researchers used the experimental method with the experimental design for one group.

Research community

The research community consists of secondary school students in Samalut Educational Administration, with a total of (11) secondary schools for girls, with a total of (4023) students in the three stages of secondary education.

Research sample

The researchers chose Samalut New Girls Secondary School as the research sample. It was randomly selected from the research community, which had (681) female students. Then, the researchers measured the body components of all the school's female students and classified them according to the components of fat mass into {obese, obese, overweight, ideal weight, thin}. The basic research sample was selected from the thin female students from the first and second grades. The sample consisted of (10) female students who met the following conditions:

- General secondary schools.
- Government schools.
- Body mass index does not exceed 16.
- Does not suffer from any chronic organic diseases.
- Accepts to participate in the research experiment and biochemical analysis and regular training.

The researchers also selected (12) female students to conduct the exploratory study to ensure the validity and reliability of the measurement tools and tests used in the research.

The moderation of the distribution of the research sample individuals:

The measurements of the research sample were conducted by finding the skewness coefficients before starting to apply the proposed program, in order to ensure the moderation of the research variables that may affect the research results in all research variables, and the values of the skewness coefficients in the variables under study ranged between (-2.24: 2.50), meaning that they were limited to ($\pm$ 3), which indicates that the distributions are close to moderation in all research variables, which indicates the moderation of the distribution of the research sample individuals.

Data collection tools

After the reference study and the researchers' review of previous studies and scientific research that concluded with the most appropriate biochemical variables and physical tests with thin secondary school students.

- **Biochemical variables**
- Hemoglobin
- Red blood cells
- Hematocrit
- Platelets
- **Physical tests**
- Trunk flexion test to measure flexibility.
- Grip dynamometer test to measure grip strength.
- Barrow zigzag running test to measure agility.
- 5 x 55 meter running test to measure endurance.

Scientific coefficients of tests:

1. Validity:

To calculate the validity of the tests, the researchers used the validity of the one-way comparison, where the researchers applied these tests to the survey sample, which numbered (12) female students, and the significance of the differences between the lower and upper quartiles was calculated, as shown in the following table

Table of significance of the differences between the lower and upper quartiles for the tests Biochemical variables

Variables	Unit of measurement	Upper quartile			Lower quartile			Z value	Significance level
		Arithmetic mean	Average ranks	Sum of ranks	Arithmetic mean	Average ranks	Sum of ranks		
Hemoglobin	Gm/Microliter	10.67	2.00	6.00	11.35	5.00	15.00	*1.96	0.050
Red Blood Cells	Cell/Microliter	3.62	2.00	6.00	3.74	5.00	15.00	*1.96	0.050
Hematocrit	%	34.67	2.00	6.00	36.33	5.00	15.00	*2.02	0.043
Platelets	310/Microliter	174.33	2.00	6.00	189.33	5.00	15.00	*1.96	0.050
Trunk Flexion	Cm	3.67	2.00	6.00	5.33	5.00	15.00	*2.02	0.043
Grip Strength	Kgm	5.67	2.00	6.00	7.33	5.00	15.00	*2.02	0.043
Zigzag Run	S	13.21	5.00	15.00	12.71	2.00	6.00	*1.96	0.050
5 x55m Run	S	1.18	5.00	15.00	1.15	2.00	6.00	*2.02	0.043

Table (Z) value at significance level (0.05) = 1.96 (0.01) = 2.58

*Significant at level (0.05) ** Significant at level (0.01)

It is clear from the previous table that there are statistically significant differences between the lower and upper quartiles of the tests under study in favor of the upper quartile, which indicates the validity of the tests under study and their ability to distinguish between the two different groups.

2. Reliability:

To calculate the reliability of the tests under study, the researchers used the method of applying the test and re-applying it on a sample of (12) female students from outside the research sample who have the same specifications as the original sample and with a time interval of (3) three days between the first and second applications. The following table shows the correlation coefficients between the two applications.

Table of correlation coefficient between the first and second applications of the tests under study (n = 12)

Variables	Unit of measurement	First application		Second application		Correlation coefficient
		Arithmetic mean	Standard deviation	Arithmetic mean	Average ranks	
Hemoglobin	Gm/Microliter	11.03	0.29	11.02	0.28	**0.94
Red Blood Cells	Cell/Microliter	3.69	0.06	3.68	0.06	**0.92
Hematocrit	%	35.75	0.75	35.83	0.83	**0.94
Platelets	310/Microliter	182.08	5.82	182.25	5.40	**0.94
Trunk Flexion	Cm	4.58	0.79	4.67	0.89	**0.95
Grip Strength	Kgm	6.42	0.79	6.33	0.78	**0.93
Zigzag Run	S	12.95	0.20	12.96	0.17	**0.94
5 x55m Run	S	1.16	0.01	1.17	0.02	**0.95

It is clear from the previous table that the correlation coefficients between the first and second applications in the tests under study ranged between (0.91: 0.95), which are statistically significant correlation coefficients, indicating the stability of the tests.

Training program content using resistance training

- Program duration: 12 weeks
- Unit duration: 60 minutes
- Number of units per week: 2 units
- Program intensity: 50: 75%

Research results

Results of the first hypothesis: which states:

- There are statistically significant differences between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables in favor of the post-measurement.

Table of the significance of statistical differences between the average ranks of the pre- and post-measurements of sample members in some biochemical and physical variables

(n = 10)

Variables	Unit of measurement	Pre-measurement			Post-measurement			Z value	Significance level
		Arithmetic mean	Average ranks	Sum of ranks	Arithmetic mean	Average ranks	Sum of ranks		
Hemoglobin	Gm/Microliter	4.60	0.00	0.00	7.50	5.50	55.00	**2.91	0.004
Red Blood Cells	Cell/Microliter	6.30	0.00	0.00	7.70	4.50	36.00	**2.64	0.008
Hematocrit	%	12.96	5.50	55.00	11.85	0.00	0.00	**2.81	0.005
Platelets	310/Microliter	1.16	5.50	55.00	1.11	0.00	0.00	**2.81	0.005
Trunk Flexion	Cm	11.03	0.00	0.00	11.45	5.50	55.00	**2.81	0.005
Grip Strength	Kgm	3.70	0.00	0.00	3.93	5.50	55.00	**2.82	0.005
Zigzag Run	S	35.80	0.00	0.00	38.80	5.50	55.00	**2.91	0.004
5 x55m Run	S	185.2	0.00	0.00	207.2	5.50	55.00	**2.81	0.005

The following table shows that there are statistically significant differences between the average ranks of the pre- and post-measurements of the research sample members in the variables of health and biochemical fitness in favor of the post-measurement.

The results of the second hypothesis: which states:

- The percentages of improvement differ between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables.

Table of percentages of improvement between the pre- and post-measurements of the research sample members in the biochemical and physical variables (n = 10)

Variables	Unit of measurement	Pre-measurement	Post-measurement	percentage improvement
Hemoglobin	Gm/Microliter	4.60	7.50	%63.04
Red Blood Cells	Cell/Microliter	6.30	7.70	%22.22
Hematocrit	%	12.96	11.85	%8.56
Platelets	310/Microliter	1.16	1.11	%4.31
Trunk Flexion	Cm	11.03	11.45	%3.81
Grip Strength	Kgm	3.70	3.93	%6.22
Zigzag Run	S	35.80	38.80	%8.38
5 x55m Run	S	185.2	207.2	%11.88

is clear from the table that the percentages of improvement between the pre- and post-measurements of the research sample members in the biochemical and physical variables ranged between (3.81%: 63.04%), which indicates the effect of the proposed resistance training program in improving those variables among the research sample members.

he researchers attribute this result to the regularity of the proposed and standardized sports program using resistance exercises that are compatible with the physical and physiological condition of the thin girls (the research sample), as it achieves its goal of improving the biochemical variables (hemoglobin, red blood cells, hematocrit, platelets). Also, regularity in sports training and its weekly training units, including resistance training, makes the body adapt to the effort expended, especially activating blood circulation. The chances of improving weight for thin girls increase through resistance training, which increases the acquisition of muscle mass and subcutaneous fat in balanced proportions instead of increasing it through the accumulation of unhealthy abdominal fat. Also, the resistance exercises used in the proposed program depend on body weight or some tools with simple weights, but the control of repetitions is achieved, which achieves the goal of the program.

he sports program units, which consist of 24 training units at a rate of two units per week, increase the opportunity to prepare the body physiologically for training and also benefit from external resistance, which urges the body to compensate for the lost calories and thus eat healthy meals necessary to continue practicing activities, thus contributing to increasing appetite for food and thus the amount of calories consumed per day will be greater, which leads to weight gain, and that the resistance exercises in the proposed program return to the girl with a harmonious body and are accepted by her, which increases her self-confidence and this result was a confirmation of the improvement in general health fitness and body composition in particular.

The adaptations that occur from regular exercise are a reflection of the physiological improvement within the body, especially in the biochemical variables (hemoglobin, red blood cells, hematocrit, platelets) and these variables under investigation are responsible for motor performance and blood delivery to the working muscles and used resistance exercises.

This result is consistent with the results of the studies of "Fleck & Kramer" (2004) (3) and "Baechle et al." (2000) (1) that resistance training has a major role in developing various skills, and the results of their research show that the use of the variable resistance training method is very important as resistance training is performed in a way that has a specificity to the sporting activity practiced, which is useful in improving the physical abilities specific to the type of activity, as well as improving the level of skill performance of the players as the motor performance of resistance training is similar to muscular work.

Thus, the results of the first and second hypotheses are verified, which state:

- There are statistically significant differences between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables in favor of the post-measurement.
- The improvement rates differ between the average ranks of the pre- and post-measurements of the research sample members in some biochemical and physical variables.

Conclusions and Recommendations

In light of the research results to achieve its goal, which came through verifying the hypotheses that were set for it, the researchers reached the effectiveness of resistance training in improving the biochemical and physical variables under study. This was shown by the presence of statistically significant differences between the average ranks of the pre- and post-measurements in favor of the post-measurement. The percentage improvement rates between the pre- and post-measurements for the individuals in the research sample ranged between (3.81%: 63.04%).

In light of the research conclusions, the researchers recommend implementing the proposed sports program using resistance exercises, and relying on daily resistance exercises within the thinness treatment protocol, ensuring that women practice sports activities daily until they become part of daily life, and the necessity of practicing resistance exercises as they bring general benefits and contribute positively to developing the level of physical and biological fitness.

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Research Summary

The current research aims to identify the extent of the effect of resistance training on some biochemical variables "hemoglobin, red blood cells, hematocrit, platelets", and some physical variables "trunk flexion, grip strength, zigzag running, 5x55 meter running". Due to the nature of the research and to achieve its objectives and hypotheses, the researchers used the experimental method with the experimental design of a single group. The research community consists of secondary school students in Samalut Educational Administration, with a total of (11) girls' secondary schools with a total of (4023) students in the three secondary education stages. In light of the research results to achieve its goal, which came through verifying the hypotheses that were set for it, the researchers reached the effectiveness of resistance training in improving the biochemical and physical variables under study. This was evident from the presence of statistically significant differences between the average ranks of the pre- and post-measurements in favor of the post-measurement. The percentages of improvement between the pre- and post-measurements for the individuals in the research sample ranged between (3.81%: 63.04%).), In light of the research conclusions, the researchers recommend implementing the proposed sports program using resistance exercises, and adopting daily resistance exercises within the thinness treatment protocol, ensuring that women practice daily sports activities so that they become part of daily life, and the necessity of practicing resistance exercises as they bring general benefits and positive contribution to developing the level of physical and biological fitness.