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**Articles and Statements**

# Dynamic Apnea in Pubertal Male and Female Swimmers

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**Abstract**

Blood lactate is an index of maximum anaerobic capacity (Troup et al., 1992). Furthermore, is a biomechanical parameter that presents the most impressive accumulation changes in muscles and blood during exercise, in a way that by measuring it we can obtain important information about maximum swimming efforts (Mougios, 2002).

Lactate accumulation in blood has been observed in several swimming tests. One of those is swimming with apnea that aims at the increase of the athlete's endurance allowing him to swim some meters underwater. However, one of the adaptations of apnea is for sure the improvement of keeping ones breath (Van-Ness, Town, 1989). Apnea remains a popular type of training for elite swimmers maybe because it also provokes other training effects that are not yet recognized (Maglischo, 2003).

The aim of this study is to examine lactate accumulation in blood and heart rate in the test of 4x50m with two different tests: a) freestyle swimming and b) freestyle swimming with dynamic apnea, between male and female swimmers.

12 male and female sprint swimmers of freestyle participated in this research. Firstly, they swam 4x50m freestyle swimming with maximum intensity. Secondly, they swam the same distance with 14-15m underwater movement and for the rest 35m they swam freestyle with maximum intensity. After each effort, blood lactate, heart rate and performance time were recorded.

For the analysis of the results, multivariate analysis of variance was applied (MANOVA). No statistical significant differences for the measured variables between the test of apnea and the test without apnea for the measured variables. Differences were only observed on performance time between male and female.

**Keywords**: swimming, apnea, blood lactate, heart rate, performance.

## 1. Introduction

The requirements for adaptive processes in high level athletes show great coaching activation, aimed to disrupt the homeostatic balance of body and force him to go to the operational adaptation necessary for high level achievements.

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Underwater movement of feet that swimmers do at the start of each race distance and each turn is a state of apnea. Apnea in humans' causes bradycardia, decreased cardiac output, peripheral vasoconstriction, systemic hypertension (Andersson et al., 2004; Ferretti et al., 1991; Foster, Sheel, 2005; Gooden, 1994; Kawakami et al., 1967; Schagatay et al., 1999; 2000), redistribution of blood to vital organs and impaired respiratory gas exchange (Kawakami et al., 1967). Until now, studies investigate the apnea under conditions of exercise on cycloergometer (Andersson et al., 2004; Bjertnaes et al., 1984; Lindholm, Linnarsson, 2002).

According to the Geladas (Geladas, 2008), the diving reflex, namely bradycardia and peripheral vasoconstriction as a result of immersion in apnea has proven to be a reflex that serves to save oxygen for the more vital tissues. This reflex is characterized mainly by a large reduction in heart rate, significant increase in blood pressure and intense peripheral vasoconstriction and occurs during both the dynamic and static apnea.

The redistribution of blood flow from the periphery to the brain or central movement is an important indication for the operation of the dive reflex as a protective mechanism for saving oxygen to vital organs.

In recent years, apart from the static and dynamic apnea, the model of repeated apnea is widely investigated. It is observed that repeated apneas may cause transient changes and lead to an increase in the duration of apnea, a phenomenon reported in the literature as a short-term adaptation of apnea (Heath, Irxin, 1968; Schagatay et al., 1999; Schagatay et al., 2001a;2005;2007; Bakovic et al., 2003;2005; Richardson et al., 2005).

The amount of blood lactate in muscle serves as a measurement of anaerobic energy production. The concentration of lactate in the blood has been investigated quite a lot in swimming procedures to determine the intensity of energy production (Aujouannet et al., 2006; Barbosa et al., 2006). The level of anaerobic capacity of swimmers can be determined by simple tests. The best test that can assess the anaerobic capacity of swimmers is the test 4x50m freestyle swimming with maximum intensity with 10'' stop which can be used to estimate the maximum lactate production (Platonov, 1977).

During both static and dynamic apnea (Ferretti et al., 1991; Joulia et al., 2002; 2003; Andersson et al., 2004), an increase in concentration of lactic acid in the blood is observed, an indication that we pass from aerobic to anaerobic metabolism due to reduced peripheral oxygen delivery caused by the intense vasoconstriction in the area.

On the other hand, people with long experience in apnea activities (7-10 years) have less or no lactic acidosis after static and dynamic apnea compared with inexperienced persons (Joulia et al., 2002). The application of a training program comprising repetitive dynamic apneas, resulted in limiting the lactic acidosis as determined by the concentration of plasma lactate and pH in both static and dynamic apnea (Joulia et al., 2003). The above change in the concentration of lactate has been linked by researchers with the paradox of lactic acid after acclimatization to severe altitude.

Breathing during free swimming and other types of swimming techniques usually is tuned to the movement of hands (Strumbelj et al., 2007).

A decrease in the percentage of heart rate found in studies of people who held their breath on the water surface (Ferretti, 2001; Lin, Hong, 1996; Manley, 1990). The same was found during the breath-holding exercise (Butler, Woakes,1987; Lindholm et al., 1999; Sundblad, Linnarsson, 1996).

Generally, there is a perception that the bradycardia increases with the dynamic apnea. In their research, Stromme et al., (Stromme et al., 1970) examined bradycardia at rest and during dynamic exercise and found that the level of bradycardia was higher during dynamic apnea. These results agree with the findings of Butler et al., (Butler et al., 1987), Smeland et al., (Smeland et al., 1984) and Finley et al., (Finley et al., 1979) except that the experimental design of Butler et al., (1987) apnea included immersion of the whole body in water with underwater swimming, and of Smeland et al., (Smeland et al., 1984) and Finley et al., (Finley et al., 1979) consisted of static and dynamic apnea with face immersion only.

It should be noted that in the above investigations, the intensity of dynamic exercise was moderate thus we do not know if at a higher exercise intensity diving reflex can occur and to counteract the tachycardia of exercise.

Underwater movement of feet as a form of exercise apnea in conjunction with regular swimming has not been studied in terms of physiological responses.

This study attempts to identify any differences between apnea swimming and free swimming.

After analyzing the various results it was confirmed that the best test that can objectively assess the anaerobic capacity of swimmers is the test of 4x50m freestyle swimming with maximum intensity with a 10'' stop (Platonov, 1977).

The purpose of this study is to investigate physiological responses after the test of 4x50 m freestyle swimming between two different protocols: a) freestyle swimming and b) freestyle swimming with 14-15 m of apnea in male and female swimmers of competitive level.

The comparison will help in assessing useful conclusions for planning and coaching in swimming and it will determine the importance of maximum concentration of blood lactate in maximum-intensity efforts, heart rate and will observe differences between two genders.

## 2. Methods

Sample

The sample consisted of 12 male and female swimmers of competitive level (male, n:6, age: 16 ± 1,6 years, height: 175 ± 8,8 cm and weight: 70,4 ± 11,8 kg, and female, n:6, age: 15 ± 1,6 years, height: 163,7 ± 9,8 cm and weight: 53,2 ± 8,9 kg). This research has the approval of ethics committee of Athens University.

Procedures

The measurements were made in an open pool of 50m. The water temperature was 26 ± 1degrees. The measurements were made during the afternoon hours of 17:00 until 7:00 p.m. and within 4 days, during the pre-competitive phase of the summer period. To ensure that all subjects are in better physical condition all the measurements were made randomly in 2 sessions. The swimmers participated in regular daily workout lasting two hours, six days per week.

Once informed of the purpose of the research and measurement procedures, the athletes gave their written consent. All subjects made a warming up of 800m under the guidance of the coach. After warming up, they rested out of the water for 15 minutes and were preparing to start the measurement.

For the purpose of the study, the athletes swam with a maximum intensity the distance of 4x50m freestyle swimming with two different ways on different days, taking into account the regulations of swimming.

The first way was to swim 4x50 meters freestyle at maximum intensity and 10'' stop between 50m with start from the water and breathing as they normally do in training and competitions, every 2 to 3 strokes. In the next session, the second way involved 4x50m freestyle swimming with the first 14-15m underwater movement of the legs and the remaining 35 meters freestyle swimming with maximum intensity and 10'' stop between 50m.

Anthropometrics

From the anthropometric data measured body height (cm) with precision scale to the nearest 0,5 cm and body weight (kg) was measured to the nearest 1/100kg with electronic precision scale 100gr with the athletes wearing their swimsuits.

Instruments

In order to determine the concentration of blood lactate immediately after each effort, capillary blood samples were taken at 3, 5 and 7 minute of recovery, and analyzed by automatic analyzer LACTATE SCOUT GERMANY.

We also recorded heart rate in the first 10'' immediately after exercise with Polar Finland 610I.

Performance time in each 50m and total time of 4x50m were recorder manually with electronic timer SEIKO WATER RESISTANT 10BAR S140.

Statistical analysis

The statistical analysis of data from blood lactate, heart rate and swimming performance at maximum repeated attempts was made by using multivariate analysis of variance MANOVA. For the investigation of individual differences among male and female swimmers and the two conditions, with and without apnea, ANOVA analysis was applied.

Values are expressed as average values and standard deviations of (M ± SD). The minimum level of statistical significance was set for all parameters at $p < 0.05$. The data analysis was done with the statistical program SPSS 22.0.

## 3. Results

All data went through descriptive statistics and normality tests (Table 1).

The results of multivariate analysis MANOVA showed a significant effect of the variable 'gender' to the linear combination of the dependent variables. The multivariable index Wilk's L was equal to 0.423, corresponding to F (3,18) = 8,185, Sig. .001, p <.05. The index $\eta^2$ is equal to 0.57, ie 57% of the distribution of the linear combination of the dependent variable was explained by the statistical effect of the independent variable 'gender'. This finding is obvious as male have generally better performance times in comparison to female.

There was no significant effect of the independent variable 'apnea' to the linear combination of the dependent variables. The multivariate index Wilk's L was equal to 0.784, corresponding to F (3,18) = 1,649, p <.05.

Finally, no statistically significant interaction occurred between the variables 'condition' and 'gender' to the linear combination of the dependent variables. The multivariable index Wilk's L was equal to 0.927, corresponding to F (3,18) = 0,47,

p < .05.

In individual level, statistical significant difference was observed only between male and female swimmers in performance time, with male presenting lower values in comparison to female.

**Table 1.** Average values and standard deviations of measured variables

| Apnea condition | gender | Lamax (mmol/l) | HR (beats/ min) | Performance (secs) |
|---|---|---|---|---|
| **4χ50μ freestyle with 15m underwater kick of legs** | male | 9,8±3,2 | 187±12,8 | 130,4±5,5 |
| | female | 11,1±2,8 | 186±7,5 | 136,8±5,6 |
| **4χ50m freestyle without 15m underwater kick of legs** | male | 10,7±2,4 | 193±15,8 | 125±3,64 |
| | female | 10,4±3,4 | 184±7,2 | 134,5±5,4 |

**Table 2.** Statistical significances for the protocols of apnea and without apnea (Anova)

| | Lamax | | HR | | performance | |
|---|---|---|---|---|---|---|
| | F | Sig. | F | Sig. | F | Sig. |
| **Apnea** | .005 | .945 | .183 | .674 | 3.403 | .080 |
| **Gender** | .169 | .685 | 1.142 | .298 | 14.044 | .001* |
| **Apnea* Gender** | .428 | .520 | .731 | .403 | .538 | .472 |

*statistical significant difference

Maximum blood lactate levels did not differ statistically between the two conditions of apnea or the two genders. Blood lactate varied at both protocols between 10,5 ± 2,8 mmol/l.

Heart rate was recorded immediately after each test at 10''. Heart rate varied at both protocols between 187,5 ± 11,2 beats per minute. The heart rate showed no statistically

significant differences between the protocol of apnea and the protocol without apnea. The average values and standard deviations of heart rate for each protocol are presented in Table 1.

Performance time, that varied between 131,7± 6,6 at the overall sample, was statistically significant different between the two genders but no difference was observed between the two apnea protocols. However, a tendency was observed for performance time with apnea, with both male and female swimmers having lower values of performance time when executing the test with apnea (underwater movement of legs).

## 4. Discussion

In this investigation, the analysis of results showed no statistical significant differences between the two protocols of apnea in the measured variables in maximum production of blood lactate, heart rate and time of performance.

When an athlete performs an attempt to swim with high intensity, blood lactate is a good indicator of intensity of swimming and can be used as an indicator of adaptation of the swimming training (Costill, 1992). Thompson & Cooper (Thompson, Cooper, 2003) found a strong relationship between submaximal swimming velocity and lactate concentrations. Avlonitou (Avlonitou, 1996) in her research reported that rates of lactic acid after competition were between 12.0 and 13.1 mmol / L for adult men and 10.5 and 12.6 mmol / L for adult women.

According to the results, the maximum production of blood lactate showed no differences between the two protocols. Similar results were observed in other sports using different protocols apnea.

The reduced acidosis in divers as endurance athletes as a result of the apnea training program can mean either reduced production of lactate from the exercising muscles or increase from other tissues (Geladas, 2008). Also, Joulia et al., (Joulia et al., 2003), examined the effects of dynamic apnea training on metabolic acidosis. The increased concentration of blood lactate in plasma disappeared during static apnea, whereas the concentration of blood lactate in the blood decreased significantly in dynamic apnea.

Heart rate showed no statistically significant differences between the protocol with and without apnea.

In contrast to the results of this research, a decrease in the percentage of heart rate was found in studies of people who held their breath on the water surface (Ferretti, 2001; Lin, Hong, 1996; Manley, 1990).

The results of this investigation are in contrast to the findings of the following investigations. Sanchez & Sebert (Sanchez, Sebert, 1983) examined in 12 subjects (6 men and 6 women) the effect of apnea on heart response to different intensities of dynamic (30 and 50 % of VO2max) and isometric exercise. The subjects in each condition had two apneas in the 30 second and 4th minute of exercise. The duration of dynamic exercise was set at 6 minutes and the static was to exhaustion. The level of bradycardia was stronger in men than women only during the second apnea in both the dynamic and the isometric exercise.

In their research Stromme et al., (Stromme et al., 1970) examined the bradycardia of apnea at rest and during dynamic exercise and found that the level of bradycardia was higher during dynamic apnea.

These results agree with the results of Butler et al., (Butler et al., 1987), Smeland et al., (Smeland et al., 1984) and Finley et al., (Finley et al., 1979). In 2002, Andersson et al., (Andersson et al., 2002) examined 8 men in cyclo-ergometer for 50min in 100W and every 5 minutes the subjects were holding their breath for 30". They found that the diving reflex managed to overcome the tachycardia of exercise.

## 5. Conclusion

According to the results of this research, apnea during maximal effort in swimming does not cause different physiological responses in relation to swimming without apnea in swimmers of competitive level.

Performance time was statistically significant different between the two genders but no difference was observed between the two apnea protocols.

This type of apnea needs further investigation with larger sample but even though there were no differences between the protocols with and without apnea, we would suggest to competitive

swimmers and coaches to include to their training program the adaptation in apnea and the underwater movement of legs for the first 15m of each 50m in training and competition as it is an integral part of swimmers performance.

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# The Comparison of Agressiveness in Sports Hockey Classes Depending on Age

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**Abstract**

The research objective was to find out and compare overall aggressiveness and its individual subcategories between observed student age categories in sports hockey classes. The sample consisted of 120 lower secondary school students from Lučenec and Banská Bystrica in the age from 11 to 14. The standardized psychological questionnaire BDHI focused on the diagnose of aggressiveness was used for gaining the factual material. As emerged from the results, weighted average score of overall aggressiveness has substantially increased in case of older students. Younger students reached weighted average score 30.76 while older ones reached 39.46. Statistical significance of variance with value p = 0.036 was validated by nonparametric Mann Whitney U test. Weighted average score also substantially differs in case of physical aggression. Older students reached weighted average score 5.45 where younger students reached weighted average score 3.70. Nonparametric MannWhitney U test validated statistical significance variance between younger and older students where p = 0.022.

**Keywords:** sports hockey class students, aggression, aggressiveness, age, BDHI questionnaire.

## 1. Introduction

Authors Jandourek (2001), Škodáček – Černovský (2004), Martinek (2009) and Dobrôtka (1999) agree that word aggression is derived from latin word "agreddi" meaning to ensure one's access, to attack, to dare, try to overcome somebody. Anderson – Bushman (2002) and David Tod (2010) emphasize fact that aggressive behaviour is in the first place behaviour not attitude or even emotions.

We agree with the opinion that aggression is certain characteristic, perosnality trait. Definition of aggression says it is an unpleasant activity against other person. According to three basic theories aggression can be understood as an instinct (S. Freud, K. Lorencz), as an acquired characteristic (A. Bandura) or as a bio-psycho-socially conditioned entity (Kariková, 2001; Pavlovský 2009; Harsa et al. 2012).

Hart – Hartlová (2004) and Výrost – Slaměník (2008) define term aggression as follows:

"aggression is an offensive or belligerent action, hostility expression against certain object, intentional attack on obstacle, person or object that stands in the way of satisfying one's need" (response to frustration).

"aggression is habituated way of behaviour with tendency to react by long term attacking, hostile focus with high promptness to aggression" (Hanušková, 2008: 168)

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Vágnerová (2004) and Výrost – Slaměník (2008) agree that aggression is a tendency to make aggressive act, to behave aggressively, it is the tendency to hurt intentionally.

Heretik (2000) distinguishes altruistic, hostile, social and verbal aggression.

On the other hand authors Výrost – Slaměník (2008) distinguish affective aggression, instrumental aggression and bullying (tyranny). The other point of view on distinguishing aggression has Blahutková (2011). She distinguishes altruistic, anticipating, instrumental, inductive and shifted aggression.

Other authors such as Burk – Durkee (1957) worked on the assumption that aggression is the complex phenomenon for which is suitable to distinguish some subcategories of hostile aggressive behaviour. They made 8 categories (items) considering them basic aggression subcategories: assault, indirect hostility, irritability, negativism, resentment, suspicion, verbal hostility and sense of guilt (Buss – Durkee, 1957).

The personality influence on sports performance belongs to greatly discussed subjects. On the one hand there are skeptics that do not admit relationship between personality and sports performance and on the other hand are those who consider personality influence for significant factor of sports activity successfulness (Silva – Stevens, 2002).

According to the Hošek (2005) the most important base of knowing athlete's personality is developmental attitude. This attitude lies in respecting the fact that athlete's personality is determined by long-term influence of three groups of factors: atheletes' inborn anatomy-physiological presuppositions; presports, sports and outsports environment; socially-educational influence (social learning):

- nonsystematic individual learning by immitation;
- institucional systematic upbringing and performance development.

According to Slepička (2006) sports activity is characterized by strong emotionality given by loaded and at the same time attractive sport programme.

Vanek (1984) and Nakonečný (2000) think that emotions at the same time influence also other mental processes as perception, imagination, thinking, memory, focus and free processes. Emotions influence sports activity by certain intensity and quality. Experience intensity relates to level of athletes' activation.

Optimal performance as Tod, Thatcher and Rahman (2012) mention comes when athlete experience adequate activation level and performance is bad or activation is either high or low.

According to Jarvis (1999) and Kunath (2001) theories of instincts suggest that sport serves for actual decreasing of aggressiveness in society in a way that enable expression of our aggressive instincts.

Fleming (2008) distinguishes three acceptable and one nonacceptable form of agression in ice hockey: tactic violance, symbolic violance, actual violance and violance with intension to heavily hurt and harm opponent – it is a form of aggression that results in grevious bodily harm.

Lauer – Paiement (2009) tell about higher rate of aggression in a game that is alarming not only for a danger of many serious healh problems that has arisen e. g. as a result of the frequent head shocks, but there is a concern that aggressive behaviour can transfer to other situations too.

Hockey studies concerning this explanation try to understand which surrounding and contextual factors increase probability of athlete's frustration and consequently athlete's aggressive behaviour. These studies showed that increased level of frustration and then more frequent aggressive behaviour relate to e. g. greater differences in score, game in deffensive position, losses and the last third of the game. (Gee – Leith, 2007).

Objective

The research objective was to find out and to compare overall aggressiveness and its individual subcategories in different age groups of sports hockey classes.

## 2. Methodology

The research is focused on the comparison of aggressive behaviour of students in sports hockey classes in relation to their age and that is the reason why the research was limited by number of students.

The sample consisted of boys in sixth, seventh, eighth and ninth year of study at lower secondary school in Lučenec and Banská Bystrica. We grouped the 6th and 7th year and 8th and

9th year of study. The age of students ranged from 11 to 14. 30 hockey students were chosen from every year. 10 from Lučenec and 20 from Banská Bystrica. Total sample consisted of 120 students. More detailed description of the sample is present in table 1.

**Table 1.** Structure of the sample

| Year | | Lučenec | Banská Bystrica | Total |
|---|---|---|---|---|
| 6th year | | 10 boys | 20 boys | 30 |
| 7th year | | 10 boys | 20 boys | 30 |
| 8th year | | 10 boys | 20 boys | 30 |
| 9th year | | 10 boys | 20 boys | 30 |
| **Total** | **n** | **40** | **80** | **120** |
| | **%** | **33.33** | **66.67** | **100.00** |

The research was carried out in february school year 2015/2016. The research was organized by standardized psychological questionnaire BDHI created by Buss – Durkee (1957) and is focused on diagnosis of agression. This test classification includes 2 hostility types (resentment and suspicion) and 5 agression types (physical, indirect, verbal, irritability and negativism). Authors created items partly on their own and partly they took them from the other questionnaires. To admit that probant acts socially undesirably items presuppose that much aggressive behaviour is natural or apologized. In formulation of the items common phrases from life are sometimes used.

Questionnaire consist of 75 items, 60 of them are patognomic in the case of positive answer, other 15 are false and patognomic in the case of negative answer – signed F.

Evaluation of hockey class students' answers was made according to key:

Calculation – sum of positive answers in individual items is RS (rough score). We get WS (weighted score ) by multiplying adequate coeficients for adequate items. WS should not exceed value 5 in diffferent items. The score of item 7 (verbal aggression) is slightly higher in our population. Sum of all results in items 1 – 8 gives total aggressiveness and their sum should not exceed 35.

- mathematical-statistical methods (calculation of the arithmetic mean, deviation, minimum , maximum, Kolmogorov-Smirnov test, nonparametric test of significance MANN WHITNEY U Test, statistical variance on 5 % level of statistical significance $p < 0.05$ (Kampmiller, 2010).
- graphic methods (tables, graphs),
- qualitative methods (comparison, analysis, synthesis, induction, deduction).

## 3. Results

The variance in weighted score can be seen in the pictures. In the tables you can see statistical significance of variance and reached minimums and maximums of individuals' particular aggressiveness subcategories.

Substantial differencies between younger and older students can be seen in case of physical aggression. Weighted average score in case of younger students was 3.70. It is lower than 5 and it means that physical aggression do not exceed standard. Increased physical aggression emerged in older students as their weighted average score 5.45 exceed 5.

The variance was validated also by Mann Whitney U test, that as the unilateral test on 5 % level of verification tells that there is verified variance $p = 0.022$ between younger and older students.

**Table 2.** Physical aggression – Statistical significance of variance between younger and older students

| Physical aggression | P | Minimum | Maximum |
|---|---|---|---|
| Younger students | 0.022 | 0 | 8 |
| Older students | | 1 | 8 |

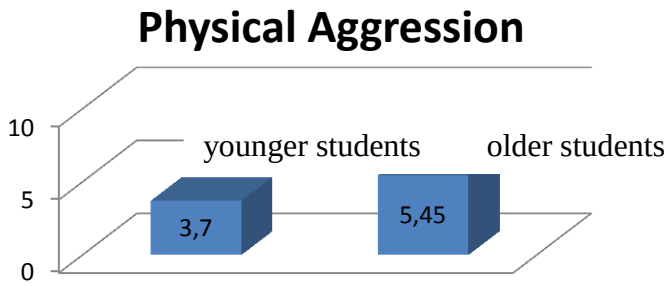


**Fig. 1.** The weighted average score of physical aggression in case of younger and older students

Results show the differance in indirect aggression between the younger and older students. Younger students reached weighted average score 2.80 while older students reached weighted average score 3.08. In this case no increased level of indirect aggression emerged either in younger or older students as the limit value was not exceeded.

Statistical significance of variance between younger and older students was validated by Mann Whitney U test that was unilateral and on 5 % level of verification tells that there is no statistically verified variance p = 0.489.

**Table 3.** Indirect aggression – Statistical significance of variance between younger and older students

| Indirect aggresion | P | Minimum | Maximum |
|---|---|---|---|
| Younger students | 0.489 | 1.1 | 8.8 |
| Older students | | 0 | 5.5 |

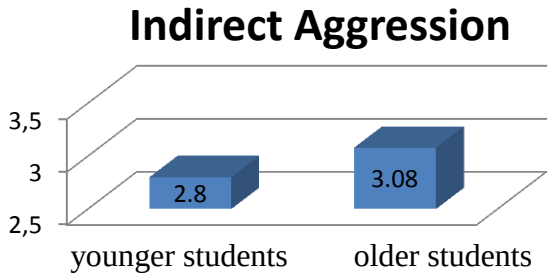


**Fig. 2.** The weighted average score of indirect aggression in case of younger and older students

The results show that younger students reached weighted average score 4.89 that means no increased verbal aggression contrary to older students whose weighted average score exceeded limit 5 with value 6.04. It means that in case of older students value of verbal aggression is increased.

Statistical correctness of variances was validated by Mann Whitney U test that in unilateral test on 5 % level of verification tells that there is no statistically verified variance p = 0.169 between younger and older students.

**Table 4.** Verbal aggression – Statistical significance of variances between younger and older students

| Verbal aggresion | P | Minimum | Maxmum |
|---|---|---|---|
| Younger students | 0.169 | 0 | 7.7 |
| Older students | | 3.08 | 9.24 |

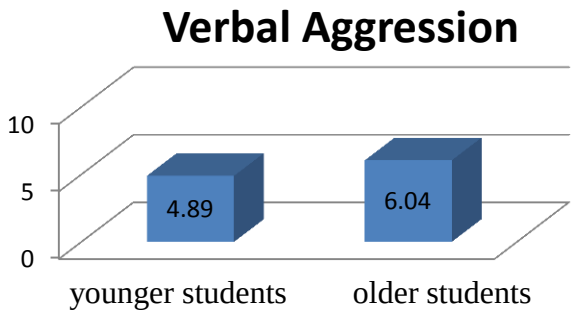


**Fig. 3.** The weighted average score of verbal aggression in case of younger and older students

Overall aggressiveness was gained by sum of weighted average score in individual aggressiveness subcategories where limit value of sum should not exceed value 35. Weighted average score in case of younger students was 30.76 and increased overall aggressiveness do not emerged. On the other hand in case of older students who reached final weighted average score 39.46 increased overall aggressiveness happens.

Statistical variance was validated by Mann Whitney U test that in unilateral test on 5 % level of verification tells that there is statistically verified variance p = 0.036 between younger and older students.

**Table 5.** Overall aggressiveness – Statistical significance of variances between younger and older students

| Overall | P | Minimum | Maximum |
|---|---|---|---|
| Younger students | 0.036 | 13.47 | 54.01 |
| Older students | | 21.58 | 55.55 |

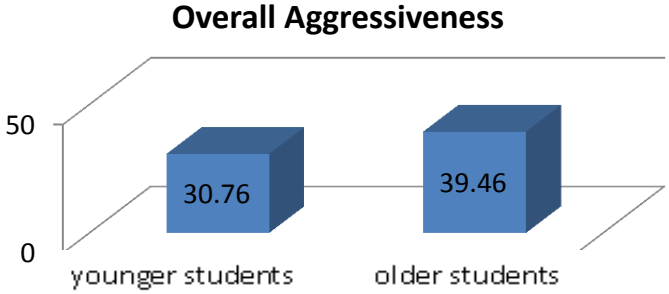


**Fig. 4.** The weighted average score of overall aggression in case of younger and older students

## 4. Discussion

Differences in individual subcategories of aggressive behaviour were compared in results and also in overall aggressiveness between younger students (6+7) year and older students (8+9) year. It proved to be the case that in every observed comparisons older students reached higher weighted averages score than younger students.

Langmaier (1998) tells that students in pubertal age reach higher values of aggressiveness than people in other developmental periods. From the stated results follows that weighted average score in overall aggressiveness have substantially increased in case of older students. Younger students reached weighted average score 30.76 while younger students 39.46. Statistical significance of variance was validated with value p = 0.036.

According to Končekova (2010) physical aggression at primary schools continually increases. As follows from the stated results weighted average score also substantially differ in case of physical aggression. Older students reached weighted average score 5.45 while younger students 3.70. Nonparametric Mann Whitney U test verified statistical significance of variance between younger and older students with value p = 0.022.

Verbal aggression is basic aggressive behaviour. Research results show that weighted averages score also differ in case of younger and older students. Younger students reached weighted average score 4.89 and older students reached weighted average score 6.04. Nonparametric Mann Whitney U test did not verified statistically signifficant variance between younger and older students with the value p = 0.169. The study of Vágnerová (2000) also proves that. Author claims that various forms of aggresssive behaviour shows more often at lower secondary school than primary school.

We agree with the Paškova's (2005) opinion. She claims that sport helps us effectively reduce aggression by helping us to gain self discipline and in higher rate is involved in creation of the value hierarchy.

Nowadays aggressiveness in sport is intensively observed subject. In the researches based on BDHI application were concerned with this subject e. g. Lenzi et al. (1997) that were finding out the relation between aggressiveness and doing sports activity (athletes had higher rate of aggressiveness than common population) or Keller (2007) who examined various sports athletes (he did not find out the difference on the level of aggressiveness). Similar research performed Šafář (2003) who also focused on several groups of athletes (he found out the higher rate of aggressiveness in contact sports (e.g. football, hockey) or Hodůrová (2011) who focused on aggressiveness of various groups of trainers and found the difference between e. g. football and handball trainers, football and basketball trainers and the like.

## 5. Conclusion

Thanks to the method of standardized psychological questionnaire BDHI and its following analysis the research objective was fulfilled.

On the basis of evaluated results, we found out that overall aggressiveness was gained by sum of the weighted averages score in individual subcategories of aggressiveness where limit value of sum should not exceed value 35. When this value is exceeded it means that overall aggressiveness is increased. Older students reached final weighted average score 39.46 and increased overall aggressiveness contrary to younger students that reached weighted average score 30.76 and normal level of overall aggressiveness (p = 0.036).

Statistically significant variances (p = 0.022) were revealed between younger and older students. Younger students reached weighted average score 3.70 that is beyond the limit 5 and so their physical aggression is normal but older students reached weighted average score 5.45 and it proves increased physical aggression.

Increased level of indirect aggression was not proven neither in case of older students nor in the case of younger students. Younger students reached weighted average score 3.08 and do not exceeded limit value 5 (p = 0.489).

The results shows that younger students reached weighted average score 4.89. It means that increased verbal aggression did not show in their case contrary to older students whose weighted average score exceeded limit 5 with the value 6.04. It means that verbal aggression value of older students is increased. To sum up, there is no statistically verified variance between younger and older students (p = 0.169).

Aggression is continually repeated subject that occurs in common life. As more authors state, aggressiveness is gradually becoming primary subject at Slovak schools. Five-year research validated that aggressive behaviour at Slovak lower secondary schools constantly increases. To stop these problems we should start to teach students good manners. To help manage and prevent stress and subsequent aggressive behaviour following from stress situations can also little things in the form of effective time management, finding time for relax and various activities with friends and family.

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# Psychological Preparation of the Sportsman in Snowboarding

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**Abstract**

Our research is focused on the influence of the snowboarder psychological preparation and on the level of changes in personal features and character with the aim of increasing her sport performance during the trials. With the questionnaire SPIDO and the test TCI-R we will find out the personal features and personal descriptions, especially the level of her extroversion or introversion, emotional stability or instability (neurocentrism). With aimed psychological preparation realized during her preparation time we will try to influence her personal features (shortterm psychological statuses) to create a better sport performance on the trials. Our partial task shows a minimal difference between the TCI-R test results and questionnaire SPIDO that happened between the entrance measurement (realized at 10.2.2015) and final measurement (realized at 27.5.2016). During the control period there was not a big difference between the results. The reason is that the pedagogical experiment was applied during very short time.

**Keywords**: psychological preparation, snowboarding.

## 1. Introduction

The psychology as the scientific field exists for a long time. Nowadays, we have many proven facts and amount of the facts is increasing. These facts are used in many fields, for example pedagogical, clinical or sport. In this paper we will try to use the psychological facts from sport field. These days, increasing attention is paid on psychological preparation. Not only the successful sportsman find out that psychological preparation is the key of success. The psychological preparation makes difference between the good one and the best one. To be more concrete, in such risky field as snowboarding, the psychological preparation plays an important role.

Psychological preparation of sportsman is an aimed usage of psychological fats to improve the activity of training system. The goal of psychological preparation of sportsman based on the psychological facts is to increase the effect of parts of sport preparation. In competition it stabilizes the performance at the level of trained capacity of sportsman. Psychological preparation is preventing the fail of performance caused by psychological reason (Slepička, 2009).

Psychological preparation as well as technical role, physical condition or tactical preparation, plays important role (Jursík a kol., 1991). As Choutka and Dovalil (1987) say the psychological preparation is focused on developing the performance motivation, regulation of the emotional processes during the trials and forming the character of the sportsman. Moravec et al. (2004) divided the psychological preparation into longterm and shortterm. Longterm preparation is focused on forming the personality, developing the properties, increasing psychological resistance,

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also the level of properties needed for autoregulation of own behaviour, thinking and feeling, increasing the self-confidence and improvement of specific cognitive abilities. Shortterm psychological preparation is focused on step-by-step forming of the psychological preparation considering the concrete trial circumstances. The aim is to make optimal regulation of actual psychological conditions and processes before and during the trial.

Psychological preparation is a process aimed on development the personal features, psychological conditions the processes. It is focused on handling the difficulties of sport training and ability to realize the whole potential of sport performance during the trials (Starší, Jančoková, 2001). The proportions and the realization of different parts vary according to the age and increasing the sport performance. The training of the children is aimed on technical preparation and the physical condition, realized on the principle of versatility. With aging and increase of the performance, the part of tactical preparation is increasing (Bence et al., 2005).

As Ruisel says (2003), the aim of the sport psychology is to observe the relations between sport and human psyche. Its role is to solve the theoretical, methodological and practical questions of P.E. and sport activity.

There are three actual psychical statuses: before the trial, during the trial and after the trial. The regulation of these statuses is motivated by subjective inconvenience of these statuses and by their negative influence on sport activity and sport performance. The before trial status occurs when the sportsman realized his or her participation on the important trial. The during the trial status lasts till the beginning of trial and can also lasts through the whole trial. The after trial status are created by subjective valuation of the trial and its results and it lasts few hours (Slepička et al., 2009). The sportsman has a specific dissimilarity compare with a normal population. Cox (1994) named them as high emotional stability, extraversion, aggressiveness, self-confidence, psychological resistance, leadership, assertiveness, and lover neurocentrism.

## 2. Methodology

Our research is focused on the influence of the snowboarder psychological preparation and on the level of changes in personal features and character with the aim of increasing her sport performance during the trials. With the questionnaire SPIDO and the test TCI-R we will find out the personal features and personal descriptions, especially the level of her extroversion or introversion, emotional stability or instability (neurocentrism). With aimed psychological preparation realized during her preparation time we will try to influence her personal features (shortterm psychological statuses) to create a better sport performance on the trials. The subject of the tests was the professional snowboarder from Slovak snowboarding association (K.M.). She is 23years old. She has got many experiences from important international and world competitions. The racer claimed that she never asked for a formal consultation from a sport psychologist.

## 3. Results

**Entering Test** TCI-R (10.2.2015)

**Table 1.** K.M. entering test Questionnaire TCI-R

| Item | NS | HA | RD | PS | SD | CO | ST |
|---|---|---|---|---|---|---|---|
| Result | 111 | 74 | 99 | 113 | 140 | 134 | 83 |
| | Searching for a new | Avoiding damages | Reliance on the reward | Endurance | Selfleading | Cooperation | Self-overlap |

Legend:
NS - Novelty Seeking
HA - Harm Avoidance
RD - Reward Dependence
PS - Persistence
SD - Self-Directendess
CO - Cooperativeness
ST - Self-Transcendence

The Table 1 shows us the results from Coninger test. **The results that are normal are written with black colour. Results that are lower than the normal results are red and the results that are higher than a normal are blue.**

We find out that during the control period the test result in question about avoiding damages was lower. The people with this result seem relaxed, carefree, courageously, brave and optimistic even in the situations that for other people seem dangerous. In the field where our racer is a world top the success is achieved by a performance that is on the edge or even far. That´s the reason why it is desirable to be carefree, relaxed, brave, and optimistic. That is the key for handling the new and difficult tricks. The lover test result is big advantage because when is there a challenge or danger she is self-confident, optimistic and full of energy. Disadvantage is when her self-confident attitude aimed lack of self-reflection can cause her a serious injury.

Higher result was in the category of self-overlapping. The people with these results are patient, creative and modest. They are enjoying the activity without the desire for controlling it or knowing the result. Other people are seeing them as modest persons who are aware of their failure. They are thankful for their successes and also for their failures.

The advantage for our racer is that she is facing the challenges without fear of failing.

Other results of Cloninger test during the control period were normal.

**Entering Test** SPIDO (10.2.2015)

The Table 2 shows us the results of questionnaire SPIDO. **The normal results are black, lower results are red and higher results are blue.**

**Table 2.** K.M. entering test Questionnaire SPIDO

| Item | KO | EM | RE | AD | OV | MH | KR | ER | KA | EA | FM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Result | 6 | 6 | 8 | 5 | 3 | 8 | 8 | 5 | 9 | 7 | 6 |

Legend:
KO -Cognitive variability
EM - Emotional variability
RE - Reacting variability
AD - Adjustment variability
OV - General level of psychical excitability
MH - Motor motivity
KR - Cognitive regulatory variability
ER - Emotional regulatory variability
KA - Cognitive adjustment variability
EA - Emotional adjustment variability
FM - Feminity

In our case the lower results from SPIDO questionnaire was in the item cognitive variability. It means that her performance is not influenced by the external impulse. Lower results were also in category adjustment variability. This results leads to maladaptive behaviour. Lower result in SPIDO category emotional adjustment variability is characterized by lower self-confidence, pessimism and depression. This can cause a problem in achieving better results in trials. The higher result was in category cognitive-regulation variability. This is characterized by adventurousness and a tendency for risky behaviour. She is emotionally stabile, spontaneous at average level and she is searching for changes also on average level. She has also the normal results in categories emotional variability and emotional adjustment variability. This means that she has a normal self-control behaviour and aspiration on normal level. From a life event point of view, she has a tendency for experience the situation not for solving them. The feminine features are on the higher level

**Final measurement TCI-R** (27.5.2016)

**Table 3.** K.M. after a control period (10.2.2015-27.5.2016) Questionnaire TCI-R

| Item | NS | HA | RD | PS | SD | CO | ST |
|---|---|---|---|---|---|---|---|
| Result | 108 | 89 | 99 | 113 | 102 | 134 | 83 |
| | Searching for a new | Avoiding damages | Reliance on the reward | Endurance | Self leading | Cooperation | Self-overlap |

Table 3 shows us the results from Cloninger test. **The results that are normal are written with black colour. Results that are lower than the normal results are red and the results that are higher than a normal are blue.**

We realized a change after a control period. The result in category searching for a new changed from lover result to a normal result.

Lower results were measured in category self-leading and cooperation. It means that the behaviour of our racer is influenced by reactions, incentives and external pressure and not by her aims and values. This adaptability can be good in the situation of entering the new community or environment. The success of a racer brings these situations. When we are speaking about lover result in category cooperation, it means that our racer is interested in her success. She can be seen as ruthless person. This makes her relationship with other racer more difficult.

The higher result in category self-overlapping was measured after the control period. It means that she is patient, creative and modest. She is capable with her failures. She is thankful for their successes and also for their failures.

Other results were normal. Same as it was in entering test.

**Final measurement** SPIDO (27.5.2016)

**Table 4.** K.M. after a control period (10.2.2015-27.5.2016) Questionnaire SPIDO

| Item | KO | EM | RE | AD | OV | MH | KR | ER | KA | EA | FM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Result | 6 | 6 | 8 | 5 | 3 | 8 | 10 | 5 | 9 | 5 | 6 |

Table 4 shows us the results from questionnaire SPIDO. The results that are normal are written with black colour. Results that are lower than the normal results are red and the results that are higher than a normal are blue.

Comparison these results with the results from entering tests bring no extreme changes. Increasing the result in category cognitive-regulation variability to 10 and decreasing the result in emotional-adjustment variability to 5 brings the same results.

The cognitive variability and reflecting the external impulses, the tendency to maladaptive behaviour, lower self-confident, higher result from cognitive-regulative variability, so adventurousness and risky behaviour, emotional stability, normal spontaneous and normal level of searching for changes are without changes. Also same are the results from categories emotional variability and emotional-adjustant variability. This means that she has a normal self-control behaviour and aspiration on normal level. The feminine features are still on the higher level

## 4. Conclusion

Our partial task shows a minimal difference between the TCI-R test results and questionnaire SPIDO that happened between the entrance measurement (realized at 10.2.2015) and final measurement (realized at 27.5.2016). During the control period there was not a big difference between the results. The reason is that the pedagogical experiment was applied during very short

time. Based on this we can expect a big affectivity of this pedagogical experiment during the preparation training period (1.6.2016 – 18.11.2016) and the main competition season (1.12.2016 – 2.4.2017). The aim of this experiment is to increase the affectivity of sport preparation with the influence on the psychological preparedness of racer.

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# The Comments on Understanding the Concept of Fitness and his Importance at Present

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**Abstract**

Understand the concept of fitness can help solving everyday problems, marked both by physical stress as well as the psychic and contribute to the prevention of chronic disease such as stress, obesity, diabetes, cardiovascular disease, digestive, and so on. a. All this could be avoided by practicing regular physical activity attractive forms through nutrition and recovery as rational. The concept of the fitness, refers to those aspects of physiological and psychological functions that protect against some types of degenerative diseases such as cardiovascular disease, obesity and certain musculoskeletal disorders. To understand this concept, experts have measurable divided into three parts: endurance, strength and flexibility. Basically, specific fitness exercises offer the possibility of acquiring and retaining an optimum physical condition, a state well, which can only have positive consequences for everyone.

**Keywords**: fitness, cardio-respiratory endurance, strength, mobility, physical exercises

## 1. Introduction

Currently, physical and mental health of people is threatened by ever-changing problems of modern civilization, marked by "industrializing" galloping all the activities that were previously resolved exclusively by means of physical activity.

On the other hand, physical inactivity and stress increasingly evident that evolve from simple fatigue to the worst forms of depression and sedentary lifestyle can lead to serious health problems such as chronic headaches , back problems, cardiovascular disease, etc., problems that can be summarized in danger of the three "S" - stress, sedentary and overweight (obesity). According to the experts, cardiovascular diseases are the leading cause of cardiovascular mortality in Europe and worldwide, with a death rate of 32 % women and 27 % men in 2004, according to data from the World Health Organization – WHO*.

According to a study conducted 19 years ago, in 1997, found that 17 % of the adult population of the world is sedentary and 60 % of the total population of the globe is not exercising enough (Lee, Skerritt, 2001), and the consequence is that malnutrition and lack of physical activity, are responsible for over 2 million deaths per year (Blair et al, 1995; Biddle et al, 2000).

The statistics of Romanian Association of Endocrinology, from 2012, show that 25–30 % of Romanian are obese (which would mean 3.5 million) and 64 % are overweight. The high

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* *World Health Organization. The Global Burden of Disease*, 2004, Part 2, p, 8.

percentage of obese people in our country - over 30 % of women and 20 % men, given that Romania ranked 3rd in Europe in the prevalence of obesity standings (after Serbia and Greece)[*].

A study in Rep. Moldova, indicating a reduction in the consumption of fruit and vegetables, except potatoes, to once a week or less, compared with the daily dose of 400 gr recommended by the World Health Organization. Hence perhaps the explanation why in Moldova, 49.2 % of the population is overweight, according to data of the World Health Organization in 2008. Overweight, besides physical inconvenience can cause serious diseases, cardiovascular, respiratory, diabetes, etc. All WHO indicate the main causes of mortality in Moldova as cardiovascular diseases, cancer and digestive pathologies.

In the actual context, everyday life, man is increasingly faced with situations increasingly more stressful, which requires the delivery of a domestic or professional, systematic and varied. These activities determined adapt the human body to physical effort and mental different intensities, under various forms, in various environments, so it requires the involvement of every individual in physical activity pleasant to adopt an active lifestyle and healthy in order to improve quality of life. In these circumstances, the World Health Organization (2010) makes recommendations on the health of the population and hence the level of physical activity you need to perform every adult to maintain an optimal state of health. Thus, every adult should do at least 50 minutes of physical activity of moderate intensity physical effort that is involved in a large number of muscles (WHO, 2010)[†].

Based on these considerations, the specialists in the physical education and the sport propose many theories and methods of practicing the physical exercise in order to be effective, depending on the objectives, which should ultimately lead to improving the functions of the apparatus respiratory, circulatory, digestive tract, and the nervous system. Improving physical condition in particular and life in general, can only be achieved through physical activity carried out in an organized manner and through a proper diet.

According the specialists, such as B. Ferrario and M. Aparaschivei (1997), believes that to improve cardiorespiratory fitness and muscle, bone health and reduce the risk of illness and depression, it is recommended at least 150 minutes physical activity of moderate intensity during the week or at least 75 minutes of activity high intensity over a week or a similar combination of the two types of activities, the activities must be carried out in half for at least 10 minutes. For additional health benefits, adults should increase moderate physical activity to 300 minutes a week or 150 minutes the intense or combine the two activities. To strengthen the muscle activities involving the major muscle groups should be performed at least twice a week.

From Anglo-Saxon literature, the term is used in our **fitness** and physical condition means. The concept of fitness refers to the ability of the individual to effectively perform any physical activity (professional sports) without completely deplete energy resources. In short the concept of fitness may be synonymous with "being in shape" or "having good physical condition."

Originally, fitness comes to from bodybuilding and today has become a much broader concept and attractive because it does not involve very large weights, the main objective is not exaggerated muscle development but rather its tone and achieving optimum physical condition. The idea of fitness experts and provoked domain: study for fitness (physical fitness), general physical fitness or competence have preoccupied E. Fleishman (1964) who has designed this concept.

M. Hebbelinck developed the concept of fitness, claiming that it is necessary to take into consideration when considering the individual's ability to move, anatomical and physiological connection between factors, strength, mobility, coordination and endurance subjects (Hebbelinck, Borms, 1969). But before defining the concept of fitness, we can appreciate that it can be summarized in the affirmative answer given to the following questions (Corbin, Lindsey, 2007):

– Can you perform daily tasks vigorously pursued without experience fatigue?

– Have you a proper body attitude?

– Have you still enough energy for leisure activities at the end of the day?

[*] *International Obesity Task Force EU Platform Briefing Paper*

[†] The survey was conducted by Magenta Consulting on a sample of 641 people. Data from this survey is nationally representative and have a margin of error of ± 3.9 % at a confidence interval of 95%. Data were collected between 2 to 10 March 2015. http://consulting.md/rom accessed 1.03.2016.

– Have you a body supple and agile?

– Can you engage in prolonged physical effort?

Concern for the education of motor skills in general was and is an interesting subject of area specialists, knowing the role they play in improving performance and driving ability of man. For this reason, motor skills development methodology equally concern both physical education teachers and coaches and physiotherapists. The physical condition of man is better, so it is healthier, this yield by practicing regular form of motion pleasant, leading to improved function cardiorespiratory improves physical attributes and body immunity, thus reducing the risk of certain diseases.

Drs H. Kraus and W. Raab (Falls, Baylor, Dishman, 1980) believes that physical fitness refers to "***those aspects of physiological and psychological functions that protect against some types of degenerative diseases such as cardiovascular disease, obesity and some with musculoskeletal disorders***".

These conditions have called hypokinetic diseases that are often associated with low levels of energy expenditure, especially in the present situation sedentary people. In turn, Harold B. Falls, Ann M. Baylor and Rod K. Dishman (1980) believes that the Fitness is "***as a form of individual enthusiasm and participation in the training-oriented sports continues to work on a higher level of life of the individual***." The concept of fitness is used in the general strategy of maintaining health, it expresses the ability to access the best quality of life, while being a "pre dynamic, multidimensional, which are based on health status and positive It includes several components: fitness, intellectually, socially, spiritually and physically" (Dumitru, 1997).

C. Corbin and Lindsey R. (1984) define fitness as "***the ability of a human to perform the effective and efficient daily work, which consists of eleven different component, different each one of them contributes to higher level private physical efficiency and the level of an individual's life in general***".

According by Philip E. Alssen, Joyce M. Harrison and Barbara Vance (1989) fitness as "***a reflection of the ability of an individual to actively work and enjoy without the emergence of an unjustified tiredness save some energy for use in promotional activities and unforeseen emergency***".

By the same authors (P. E. Alssen, J. M. Harrison and B. Vance 1999), fitness designate a set of attributes "skills" that individual cope with the physical and functional daily activities or sports addicts provided to anatomical, physiological, and psychological.

After C. Ulrich (2000), physical condition/fitness as "***the capacity of the human body to function with vigor and alertness, without undue fatigue, with enough power to engage in leisure activities and prevent physical stress; muscular strength, endurance, cardiovascular fullness and liveliness are visible signs of physical condition.***"

And Charles B. Corbin and Lindsey Ruth (2007) believe that there is a close relationship between physical activity, fitness, health and beauty (Figure 1).

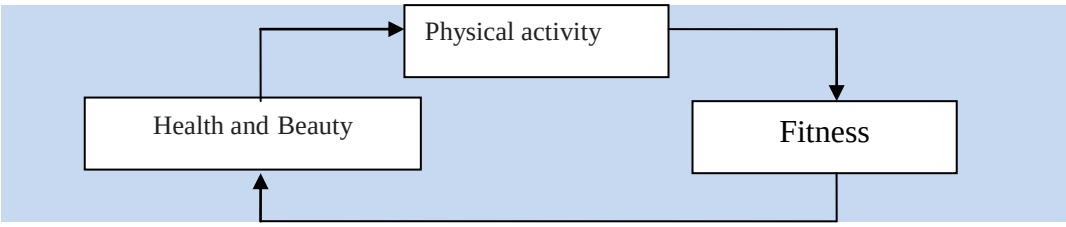


**Fig. 1.** The Cycle of the beneficial physical activities

On the other hand designate fitness and sport, akin to bodybuilding but puts more emphasis on harmonious development of muscles using exercises that use lower weights with more repetitions. The ultimate goal of practicing fitness is to develop a healthy body, balanced with a smooth and well-defined musculature.

Cannot really talk about fitness unless they regard its basic components, which are (Pate, 1983):

a. - **Cardio-respiratory endurance** – the body's ability to carry oxygen and nutrients to muscles and retrieve resulting products of metabolism;

b. - **Muscular strength** – the maximum force that can develop a muscle in a single contraction;

c. - **Muscular endurance** – the ability of the muscular system to perform the number of repeated contractions a muscle or muscle group can perform against a resistance without fatiguing.

d. - **Flexibility (Mobility)** – the ability to move a joint through its full range of motion normal;

e. - **Body composition** – refers to the amount of lean mass relative to the amount of body fat on a given individual.

These components are primarily dependent on the health status, which means that any individual can improve their fitness, even without special skills.

Identify and describe the components of fitness is a difficult issue, there is no unanimity among experts. Thus, E. Fleishman, one of the specialists in the field and creator of the school in July decade of the twentieth century, identify new factors (1964): flexibility extension, dynamic flexibility, explosive strength, static strength, dynamic strength, trunk strength, overall body balance, overall coordination and stamina (cardiovascular endurance).

In turn, H. B. Fall (1965) and he still emphasizes nine factors: athletic condition, the maximum metabolic, respiratory capacity, diastolic pressure, heart response during exercise, expiratory capacity, blood pressure, pulse at rest and dynamic force.

L. Denisiuc (1967) considers that the main factors are: strength, power, speed, agility (coordination), mobility and endurance.

M. A. and T. Zuiderma A. Baumgartner (1974) identified four factors of fitness, common for men and women, decisive in this respect: upper body strength and endurance; trunk strength and endurance; explosive power and endurance feet; cardio-respiratory endurance.

R. Kovar (1980) sets out four categories: maximum static and dynamic force; the rate of reaction of the invention; local muscular endurance total aerobic; dexterity, coordination, balance, spatial orientation; joint flexibility.

B. Tancred (1995) described the nine components that define in more detail the concept of fitness:

1. **Force** - the muscle response to a force that opposes resistance.

2. **Power** - the ability to exert maximum force through a move as soon as possible. The two components of power are strength and speed.

3. **Agility** - the ability to perform sudden movements in quick succession and opposite directions (ex: Running zigzag).

4. **Balance** - postural control both moving and stationary.

5. **Flexibility** - the ability to perform a wide range of movements without any physical impediments (ex: musculature in excess, excess fat, etc.).

6. **Local muscle endurance** - the ability of muscles to sustain a lengthy effort in optimal conditions (ex: pedaling, rowing).

7. **Cardiovascular endurance** - the ability of the heart to supply blood to active muscles and its ability to use blood provided by heart (ex: long distance running).

8. **Strength endurance** - the ability of a muscle to make a maximum effort repeatedly over a period of time.

9. **Coordination** - the ability to control body movements and perform properly in order to obtain maximum efficiency.

The main difference between the subjects using free weights and machines in preparation is given by the way in which the focus is on fitness components (as in physical condition). Thus, while practicing bodybuilding requires a strategy for training oriented clearly towards the development of muscle mass as large relative to the criteria of symmetry, proportion, definition, outline, separation, vascular muscle groups in practicing fitness, tracked more muscle definition and tone, together with improved cardiorespiratory function. Even if many people go to a bodybuilding gym/fitness without clear intention of sport performance, it is very important to set goals at the beginning so that it can be adopted best "strategy" of training. As most of those who end up in a gym not only aim to increase muscle mass, but also improving physical fitness, increasing

moderate tone and muscle mass and possibly reducing the layer of fat, an approach fitness exercise is more suitable, being necessary to focus on a sensible diet and adequate recovery.

The state of fitness (physical condition) is influenced by age, sex, constitution individual – somatic type and his lifestyle. Everyone starts life with a potential morphological and functional, largely genetically determined, which sets limits for health and fitness. Body shape, somatic typology which he belongs, the type of metabolism, bone structure, size and condition of the heart, the lungs, the number of muscle fibers, their type is determined at birth. Some experts believe the main means by which to achieve the objectives of this sport are: exercise, specialized equipment (free weights: Hanta, dumbbells, bars, discs, special facilities: banks of various shapes and sizes, fixed and adjustable, weight sliding engagement with cables – Butterfly Machine, gym on machine or levers or multi-functional protective equipment), food (proteins, carbohydrates, lipids, vitamins, minerals and water) and recovery (after exercise). Everyone can benefit from practicing physical exercises, but depends only on the practitioner if he can mobilize in this direction.

In order to strengthen the above, we can talk and U.S. specialists concern regarding fitness. Thus, to determine the fitness level of a person Presidential Council for Fitness in S.UA divided into three parts fitness measurable: endurance, strength and flexibility.

1. **Resistance/Endurance** is defined as "the ability to make a physical effort as optimal for long periods of time." We can speak of two types of cardio and muscle resistance. Cardiorespiratory resistance is the ability of the heart and lungs to provide oxygen and nutrients muscle via the blood. Aerobic exercises like running, cycling, swimming, increase cardiorespiratory capacity, this, right dosage, burn calories and also reduce blood fat, helping to maintain body weight under control. A system with good cardiopulmonary fitness, reduce risk of death from heart attack and lung disease. Endurance fitness is “the ability to sustain the necessary activity level for a specific competitive sport. It includes both cardiovascular and muscular endurance required for the sport”.

When it constitutes an exercise program to increase cardiorespiratory fitness community take into account the following indicators:

a. ***Type of activity*** – activity must use large muscle groups and must be maintained for a long period of time.

b. ***Intensity*** – average intensity to increase cardiorespiratory fitness in healthy adults start at 60-70 % of functional capacity known as maximum heart rate.

c. ***Duration*** – year duration will depend on the intensity. Usually low-intensity activities such as walking can take longer than high-intensity exercise such as running. An adequate level of fitness can be achieved by alternating low and high intensity activities such as walking sandwiched between brief periods of running. It is recommended 15-60 minutes of aerobic activity continuous or discontinuous.

d. ***Frequency*** – Aerobic activity should be performed 3-5 times a week. e. The rate of progress - the first 6-8 weeks of training will take place significant progress in cardiorespiratory capacity. For this progress continue, the practitioner must properly adjust the intensity and duration of activity.

e. ***Stages of the progress***. There are three stages in the aerobic resistance:

1) *The initial phase of adaptation* - during the first 4-6 weeks are recommended reduced levels of 10-15 minutes at 60-70 % of maximum heart rate.

2) *The adaptation phase* - initially there is a slight increase in the intensity exercises after this length of service is increased every 2-3 weeks.

3) *The maintenance Phase* - normally after 6 months of aerobic workout, average person will achieve the goal of getting a corresponding level of fitness and wants only to maintain this level. It is sufficient for an exercise program at a level of 60-70 % of the maximum rate of the heart executed three times per week.

The second type of resistance that must be developed in order to have an appropriate level of fitness is muscular. This is defined as the ability of muscle to perform contractions over long periods of time.

2. **Muscular strength** is another measure of fitness and is divided into two categories:

a) Static force (isometric) it does not change the size of muscle fibers.

b) Force dynamic (isotonic) muscle fibers are modified dimensions shrink.

The force can be increased by static contraction of the muscles using isometric exercises or dynamic exercises that use heavy weights that allow a small number of repetitions.

3. **Flexibility**, the ability to move muscles and joints throughout their course naturally. The low elasticity favors accidents, decreases the yield and quality of execution. There are several advantages that presents this sport:

- It is never too late for anyone to start practicing fitness exercises;
- It does not take much time training and are very effective;
- The body becomes more robust and more resistant to disease;
- Can reduce the layer of fat in a nice way;
- Heart and circulatory system are involved throughout;
- Can maintain an optimal weight without harsh diets;
- Eliminate the daily stress;
- Cultivating self-confidence.

Not least, it should be considered a beneficial influence on fitness exercises to achieve and maintain an optimal body weight. Weight fluctuations may be caused by issues such as age, sex, type of everyday activity, somatic typology (ectomorph, endomorph, mesomorphic), various biological disorders etc.

## 2. Materials and Methods

In organizing study nature found ameliorative, we considered combining several research methods that help us understand how it is understood term leisure, how leisure by those who chose to follow a by means of physical training with fitness gym, under the guidance of a specialist and the possibilities to streamline it out.

Assuming work - if modeling training program will be made according to the needs and particularities of individual will or might not change indicators physical condition in order to improve them, we tried to determine the needs and particularities age of ten practitioner's fitness exercises, which had the objective of achieving and maintaining physical fitness.

In the preparatory exercises were used to ensure a gradual increase in heart rate, increased body temperature, walking device training for next effort, increasing mobility of the joints. In the preparatory exercises have been included low intensity: various basic steps (march, step cross - "cross" open-step, step touch, etc.), different jumps (skip, pone, etc.). Also in the preparatory were used, small dumbbells of 0.5 kg, 1kg and 2kg, which steps have been completed. The preparatory lasted about 10-12 minutes.

Fundamental part of the training was oriented towards increasing the heart rate, increasing the functional possibilities of the body (possibly cardiovascular, respiratory and muscle), increasing caloric consumption and motor skills development, for a total of 30 minutes.

At the conclusion of training they were targeted following objectives: the gradual decline of the effort, the gradual decrease in heart rate, relaxation of muscle groups involved in the effort.

To determine the correct silhouette women young age practicing fitness aerobics, we conducted testing anthropometric indices (circumference of chest, waist, pelvis in cm, body weight in kg and BMI), physical qualities (strength under stress the back muscles, arms, abdominals and legs, spinal mobility, general resistance).

## 3. Results

After testing young women age and after processing the data recorded by mathematical statistical methods, the data points were determined anthropometric and physical qualities, after six months of research, presented in Table 1.

Anthropometric data points have shown dynamic growth of final results in comparison to the original. To correct figure within hours of aerobic fitness was implemented in fitness-aerobic exercises special nature of force, which helped correct body segments dynamics, it shows the results in Figure 2 and Table 1.

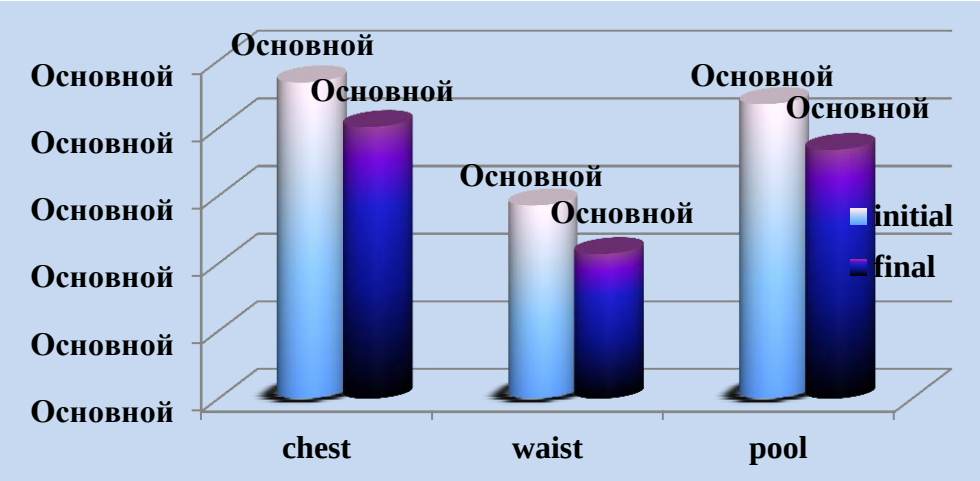


**Fig. 2.** Circumference (cm)

Group tests on samples of anthropometric indices demonstrates the effectiveness of experimental methodology on all parameters with t-student criteria for t = 2.41 chest circumference, waist circumference, t = 2.57, circumference of the basin, t = 2.36, which also showed statistical significance threshold of P <0.05, Figure 2, Table 1.

**Table 1.** Dynamics of average indices of the physical qualities and anthropometric data

| PARAMETRII | | | No. crt. | Statistical features , n=10 | | | |
|---|---|---|---|---|---|---|---|
| | | | | X | | *t* | *P* |
| | | | | initial | final | | |
| Anthropometric data | Circumference (cm) | chest | 1. | 98,4±1,74 | 95,1±0,82 | 2,41 | <0,05 |
| | | waist | 2. | 89,3±1,74 | 85,7±0,72 | 2,57 | <0,05 |
| | | pool | 3. | 96,8±1,85 | 93,4±1,02 | 2,36 | <0,05 |
| | Body mass (kg) | | 4. | 72,6±1,64 | 68,7±1,13 | 3,07 | <0,05 |
| | IMC | | 5. | 29,2±1,02 | 27,4±0,82 | 2,46 | <0,05 |
| Physical qualities | Force under stress muscle (no. of rep.etitions) | back | 6. | 24,6±1,43 | 29,3±1,13 | 4,19 | <0,01 |
| | | arms | 7. | 12,8±1,43 | 17,4±0,82 | 4,11 | <0,01 |
| | | abdominals | 8. | 23,4±1,23 | 27,2±1,02 | 3,87 | <0,01 |
| | | right | 9. | 4,6±0,92 | 6,3±0,72 | 2,33 | <0,05 |
| | | left | 10. | 3,3±0,82 | 4,9±0,62 | 2,66 | <0,05 |
| | joint mobility (см) | Leaning forward from the position standing | 11. | 26,7±1,95 | 22,6±1,23 | 2,71 | <0,05 |
| | General resistence (units) | Step-test Harvard | 12. | 60,6±1,13 | 56,8±0,92 | 2,53 | <0,05 |

n=10 (f=9) *P*<0,05 *t*=2,262*; P*<0,01 *t*=3,250*; P*<0,001 *t*=4,781

The statistical significance threshold of P <0.05 and t = 3.07 manifested and body mass Figure 3. Same demonstrate dynamic growth compared with the final results and initial body mass index criteria with t-student t = 2 46, Figure 4. This positive trend is due to circumferences

practicing exercises with the aerobic nature of aerobic fitness that contributes to fat burning, shrinking perimeters of focusing muscles and body segments of women.


**Fig. 3.** Anthropometric data: body mass (kg)

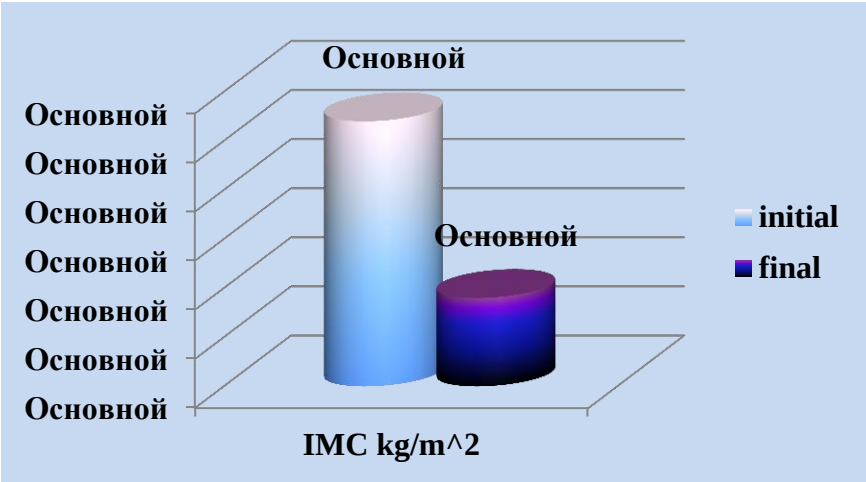


**Fig. 4.** Anthropometric data: IMC (kg/m$^2$)

The dynamics of physical qualities, the best data were observed under the force of resistance of the back muscles with t = 4.19 and t = 4.11 with muscles, arms and abdominal muscles with t = 3.87, which showed statistical significance P <0.01, Figure 5.

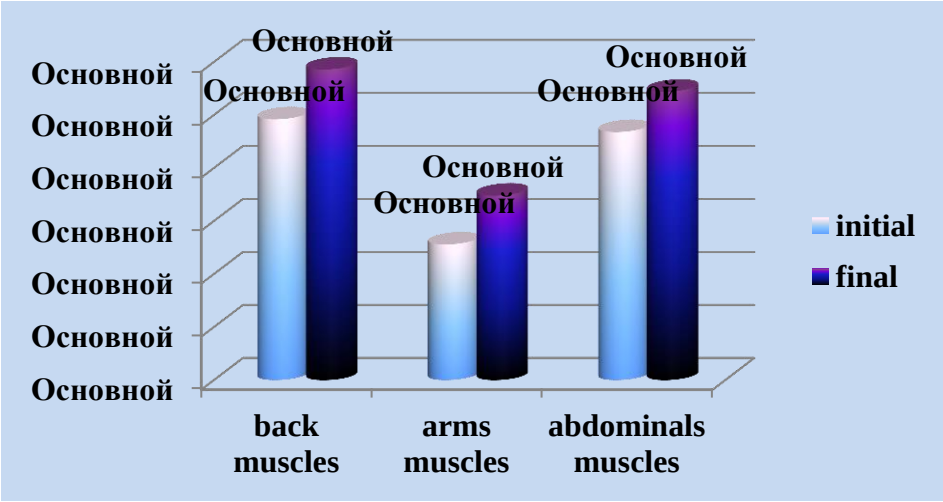


**Fig. 5.** Force under the muscle strength (no. of repetitions)

Parameters force under the right leg muscle strength with muscle t = 2.33 and t = 2.66 left foot with presents, but the statistical significance of P <0.05, Figure 6, Table 2.

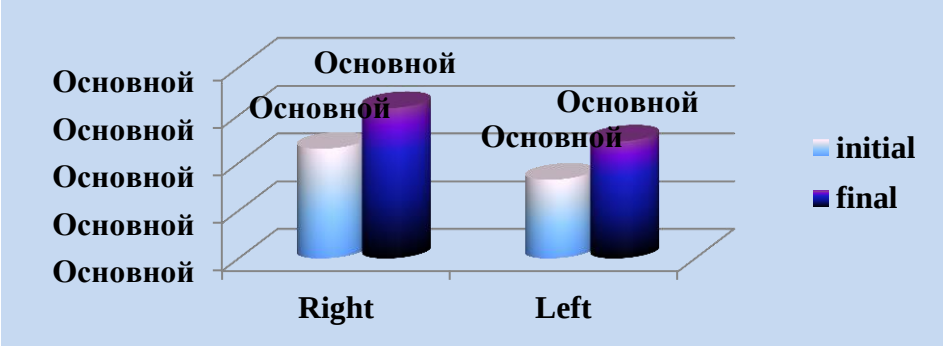


**Fig. 6.** Force in the regime muscle strength (no. of repetitions)

A positive result showed and spinal mobility with t = 2.71 which was manifested at the threshold of P <0.05, Figure 7. This is explained by the fact that the elasticity developed in the end of the lesson through special exercises stretching, stretching and relaxation of all muscle groups.

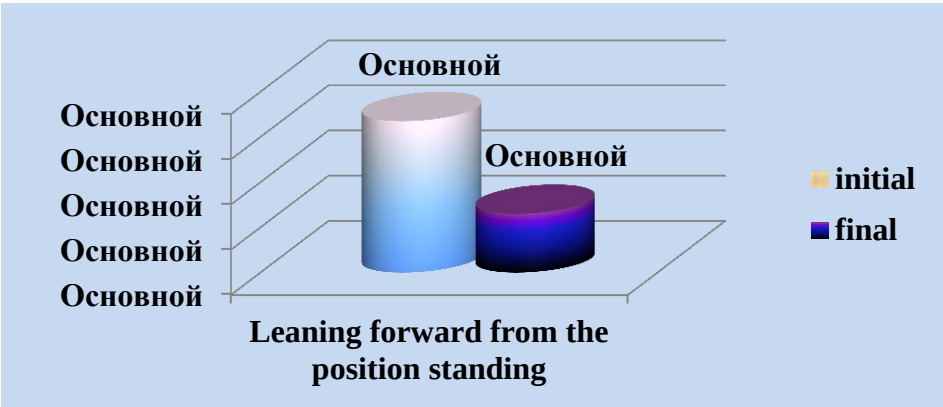


**Fig. 7.** The mobility of joints (no. of repetitions)

Basically the focus was on correcting figure by practicing the exercises aerobic nature of force. They were used during lessons with special exercises small dumbbells, body bar, the super sculpt exercises that are specific muscle strength and power development under stress.

Positive dynamics shows that the overall resilience demonstrated a t = 2.53 and statistical significance of P <0.05, Figure 8. During practice lessons aerobic fitness after experimental methods, women have gradually adapted to effort, partly weakened, and the result proves that the general resistance testing after his Harvard step test which visibly improved.

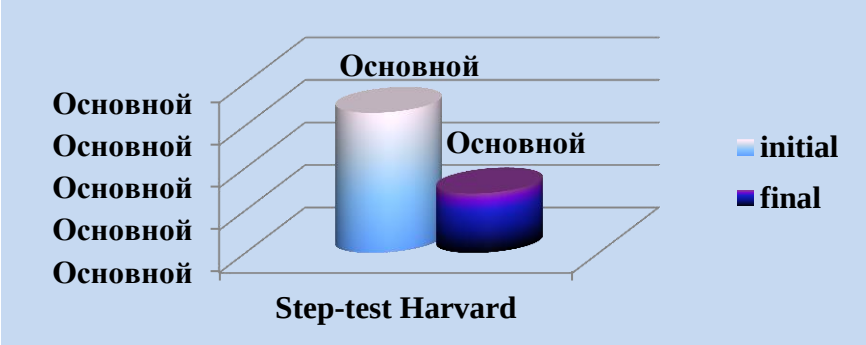


**Fig. 8.** General resistance (units)

In Table 1 we see the dynamics of figure correction them women young age as a result of attending daily workout fitness aerobic nature of force, which contributed to decrease body fat and decreasing circumference body of young women, which allowed to fall in kilograms and correct silhouette for women.

In general, we can mention that implemented new experimental method was effective on all parameters, as the final testing all results were statistically signifying a positive dynamic and truthful with P <0.05 to 0.01.

It has been demonstrated that there is a correlation between fitness training, aerobics and correcting figure in women.

Comparing the results obtained by practitioners at the end of training all the parameters that characterize their morphofunctional development, we can say that the majority of samples supported the experimental group showed better results than the control group. These results differ considerably and have a high significance level p <0.01.

## 4. Discussion

Currently, the great variety of forms of fitness to practice, make more people to turn to gyms. Thus, of these forms of fitness are:

A. *maintenance gymnastics, toning gymnastics*: tone up, slightly impact aerobics (LIA-low impact aerobic), high impact aerobics (HIA – high impact aerobics), pilates, Yogilates, stretching, master stretch, reebok flexible strenght, body – home fitness, aerobic Latin dance, Zumba (Zumba Gold, Zumba Toning, Aqua Zumba, Zumbatomic, Zumba in the Circuit), funk cardio-funk jump street dance salsa rose, hip-hop, body jam – city jam, etc.

B. – *gymnastics and dance using various objects or devices*: dance step (Step - aerobics), power step, fitball, bosu, Kangoo Jumps, body sculpt, power sculpt, elastic-rubber-band, cardio-training, spinning / body- bike, body-pump, chi ball, core training, etc.

C. – *gymnastics, dance and disciplines kombat*: body attack, tae bo, body kombat, aeroboxing, adidas punch- boxing, a boxing (boxing aerobics), contact drunken aerobickboxing, fit-box, Yoseikan, etc.

Recent studies show that exercise has the effect of improving metabolism (calorie burning) not only during their making, but a while later. Specialists say that in order to lose 1 kg of fat to be burned about 7,700 calories. A regular exercise for 15-20 minutes a day will lead to visible results in a few months. In addition, the scale is the surest measure of the health of the body. A person can have the same weight and burning fat while increasing muscle mass. It is known that diets and have the effect of lowering and muscle mass, as opposed to the fitness, which contributes to an

increase in muscle mass at the expense of adipose tissue. For example can be seen below effects of different sports on weight loss (Table 2).

**Table 2.** Various physical activities and calories lost per hour

| Physical Activities | Calories lost |
|---|---|
| running (10 km) | 900 calories |
| swimming (average speed) | 270 calories |
| tennis (simple) | 400 calories |
| skiing | 700 calories |
| walk (5 km) | 200 calories |
| cycling (10 km) | 240 calories |

The fitness exercises are conducted for overcoming some resistance movements, which can be measured in kilograms namely its own weight, free weights, machines etc. Weight training involves a variety of exercises performed in the gym with your own body weight (pushups, traction, etc.), free weights (dumbbells, barbells, discs, bars, etc.), which can add isolation exercises, using various devices (banks, pulleys, butterfly machine, presses, etc.). By using free weights lighter than those used by bodybuilders, fitness practitioners pursuing several objectives such as:

- Weight loss by reducing the amount of fat;
- Obtain and maintain a high muscle definition and tone;
- Improving major functions - circulation, respiration etc.;
- Development of motor skills, etc.

Characteristics of exercise:

– sphere of influence biological, physical but also the mental;
– systematically repeated by objectives;
– can adapt according to gender, age, degree of physical training;
– exercise content is determined by body movements or segments;
– is quantified by volume, intensity and complexity.

To achieve these objectives, practitioners may use a variety of exercises included in a program appropriate to the age, sex, level of prior training etc. In addition to exercises with weights, practicing various sports branches and aerobic exercise have a very important role in achieving an optimal state of fitness and ensure a feeling of comfort for the body, the names of these exercises it draws attention to the importance that has breath and adjust them to these exercises . At the same time, it must not forget that aerobic exercise should be associated with the anaerobic (weight lifting) to give the best results. Furthermore, E. Columban (2008) shows that there are similarities as there are differences between exercise and everyday movements (Table 3), the conclusion is that exercise can be practiced by anyone, anywhere, anytime, but anyway.

**Table 3.** Similarities and differences between exercise and daily movements

| SIMILARITIES | |
|---|---|
| **Calls physical and mental stress. Included in driving acts.** | |
| DIFFERENCES | |
| **Physical exercices** | **Daily movements** |
| It is a voluntary movement . | Not pursue specific objectives related to body or health development. |
| Its structure is specially constructed to achieve goals, accurately and efficiently. | Not classified in a special process organized . |
| It is used in a process organized or employed , but observing certain rules | There are selected to determine the effects of natural or organic. |
| It is built on the basis of principles and rules that ensure the correct orientation of his influence on the body and health | Their main role is to work and travel. |

| | |
|---|---|
| His influences can be set and monitored to determine the desired effects on the physical and psychic | Tangible changes are not predictable and controllable obtained. |
| It is repeated systematically to increase efficiency and motor skills development | Sometimes deficiencies can develop professional attitudes. |
| Can develop and improve skills , motor skills and motor skills needed in the labor process | No specific sport skills develop. |
| Can develop moral qualities , influences affection | Education have very little effect on the psyche. |

Aerobic exercise increases the amount of oxygen delivered to muscles and allow it to function at its best for longer. They must be executed over a period of at least 15 minutes without intermission, and for results to be noticeable, it is good to be performed daily, as any activity that increases your heart rate for a longer period of time will result in final improving fitness.

Exercises in terms of planning, it is difficult to set a standard, since the degree of individualization is too high, and so it is appropriate to conduct customized training programs, depending on the particular reactions of each individual body.

The Aerobic exercises may be indicated: aerobics, jogging, walking, treadmill, bike, jumping rope, etc.

## 5. Conclusion

In conclusion, as no medication cannot remedy the harmful effects caused by lack of exercise, nutrition irrational conjunction with alcohol, tobacco or drugs, an optimal alternative can be a hectic life, the practice of physical activity in organized under the guidance of an instructor specialized in fitness to be an everyday choice.

## 6. Recommendations

Most of the effects of physical activity, such as higher energy or mental state better, longer occur after the start of physical activity, and some of the most important benefits occur after several years of regular physical activity. Understand the concept of fitness can help us to cope successfully everyday problems, marked both by physical stress and the mental stress and many diseases contemporary - inactivity, obesity, diabetes, heart disease, depression could be avoided through the practice of regular forms of exercise through a rational nutrition and rest to match.

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# Effect of Exercise Machines on Sweat Loss during Exercise

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**Abstract**

This study was undertaken to investigate the effect of different cardio machine exercise on the sweat loss. Twelve subjects (6 male and 6 female) in the age range 20 to 35 years were taken as subjects in the study. Subjects were asked to exercise for 30 minutes on each machine while maintaining the exercise intensity in between 65 % to 75 % of maximum heart rate. On each machine before and after exercise, weight of the subjects was measured in kg. During exercise the temperature and humidity of the room were maintained at 26° C and 54.3 % respectively. The data so obtained in the study was analyzed using the randomized block design where gender was the between factor and machine was the within factor. The analysis showed that the effect of exercise machine on sweat loss was significant whereas the effect of gender and interaction (gender × machine) was not significant. Significant sweat loss occurred on treadmill in comparison to bicycle ergometer and stepper. No difference was observed in the amount of sweat loss on bicycle ergometer and stepper. On the basis of the study it is concluded that the reduction of weight due to the sweat loss should not be seen as a reflection of amount of fat reduced from the body during exercise. The study suggested that the cycling and stepper should be preferred over treadmill running as the weight loss due to sweat production was significantly lower than the treadmill.

**Keywords**: treadmill, bicycle ergometer, stepper, mixed design.

## 1. Introduction

Any weight loss or a weight management programme in the fitness centres includes moderate to high volume of endurance workouts in treadmill running, cycling, staircase etc. These workouts lead to burning of fats and breaking down of hydrocarbons into water and carbohydrates along with heat. This heat further enhances the core body temperature which in turns enhance the peripheral body temperature and is finally decimated into the environment through evaporation (sweating) and radiation. Thus, the sweating is a via-medium of heat regulatory system of the body and its magnitude is not much related with the magnitude of reduction of body fat.

The review of literature clearly indicates that the rate of dehydration has a negative impact on the performance and intake of water during exercise has been preferred over pre-exercise intake for avoiding deteriorating performance (Murray, 2007). The effect has been specially found on the cardiovascular efficiency. Further the Vo2 max and the Exercise intensity has found to be significantly related to sweating. The literature also suggests a gender based effect on sweating (Greenhaff, Clough, 1989).

The literature review indicates a large number of study on the sweat loss and its effect on

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performance of an individual (Murray, 2007) along with different hydration modes and timings on sweat loss and performance. However, the effect of different exercising machines on sweat rate was hard to find. Thus the present study aimed at studying the effect of different cardiovascular training machines on the sweat rate.

## 2. Materials and Methods

### *Participants*

Twelve healthy subjects (6 male and 6 female) in the age group 20 to 35 years were randomly selected from the fitness centre.

### *Measures*

Sweat loss of the subjects were measured in gram by measuring the weight of the subjects before and after the cardio exercise on different machines.

### *Procedure*

The subjects were requested to avoid any alcoholic product from 24 hours prior to the data collection to the completion phase. They were also requested to avoid any stimulant one hour prior to the exercise. With prior consent, the subjects were asked to exercise for 30 minutes on three different machines (Treadmill, Bicycle ergometer and Stepper) on different days as per the protocol of the study. The cardio intensity was kept in between 65 % to 75 % of the maximum heart rate. Sufficient time gap was kept between the two testing. The temperature and the humidity of the training hall were maintained at 26° C and 54.3 % respectively. Sufficient time period was given for recovering into normal condition. The pre and post weight of the subjects was recorded in kg with same minimal clothing.

### *Statistical Analysis*

A randomised Block Design (RBD) was used with repeated measures in which gender was used as a blocking factor and Cardio Machine as within subject factor to study the sweat loss. In this study, gender was between-subjects factor whereas cardio machine was within-subjects. In order to remove the order effect counterbalancing was done in the design. Subjects in male and female categories were divided into three groups. As per the protocol in the first phase of testing the male subjects S1 and S2 were tested on treadmill, the subjects S3 and S4 were tested on bicycle ergometer whereas the subjects S5 and S6 were tested on the stepper. Similarly, the testing protocol for the subjects during second and third phase of testing was followed as shown in Figure 1. Similar protocol was followed for female subjects.

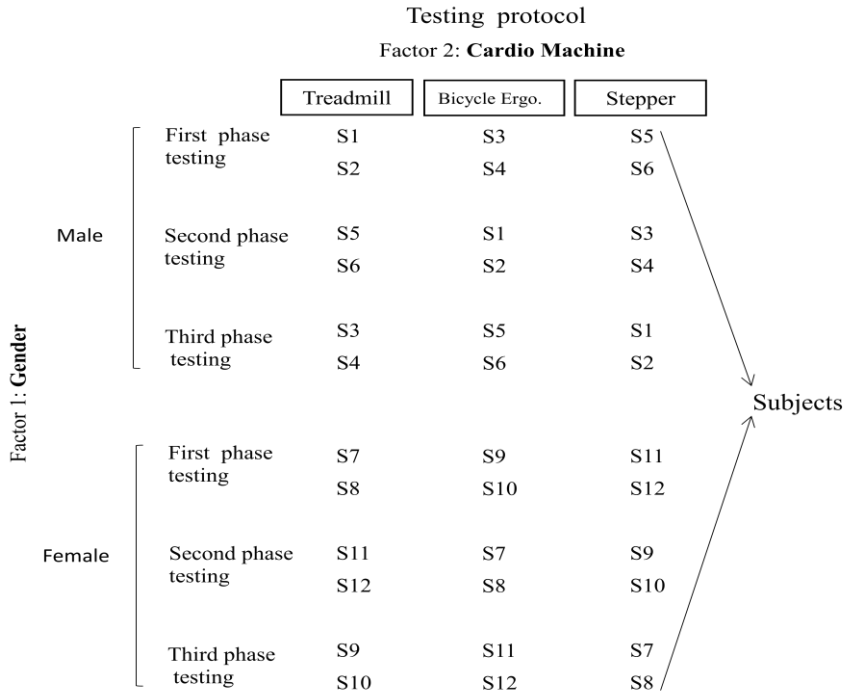


**Fig. 1**. Layout of Repeated measures design organized with randomized block

## 3. Results

Assumptions for the repeated measures design used in this study were tested before analyzing the results of the study. The assumption of normality was tested by using the Shapiro-Wilk test. The Shapiro statistic was not significant in any of the group hence assumption of normality was not violated.

Homogeneity of variance was tested by using the Levene's test. This test was not significant for all the between subject group hence the assumption of homogeneity of variance was not violated. Box's M test was used for testing the equality of variance covariance matrix in male and female groups. Since this statistic was not significant hence this assumption was also not violated.

The assumption of Sphericity was not violated as the Maucly's W test statistic in Table 1 is not significant (p>0.05). Hence no correction was made in the degrees of freedom of different sums of squares.

**Table 1.** Mauchly's test for assumption of sphericity

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|---|
| Machine | Sphericity Assumed | 0.174 | 2 | 0.087 | 54.617 | 0.000 | 0.845 |
| Machine * Gender | Sphericity Assumed | 0.010 | 2 | 0.005 | 3.017 | 0.072 | 0.232 |
| Error(Machine) | Sphericity Assumed | 0.032 | 20 | 0.002 | | | |

**Table 2** F-table for testing significance of within subject effect of machine

| Mauchly's W | Approx. Chi-Square | df | Sig. | *Epsilon* Greenhouse Geisser | Huynh-Feldt | Lower bound |
|---|---|---|---|---|---|---|
| Machine | 0.951 | 0.451 | 2 | 0.798 | 0.953 | 1 | 0.5 |

Table 2 shows that the effect of Machine is significant(p<.001) whereas interaction effect is not significant (p>0.05) hence only the main effect of within subject (Machine) was investigated further. Since partial eta square was 0.845 hence meaningful difference existed among the effect of different machines on sweat loss. Since Gender effect in Table 3 is not significant hence it may be concluded that the Gender is not an extraneous factor in the experiment.

**Table 3.** Tests of between-subjects effects

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Intercept | 3.993 | 1 | 3.993 | 2906.593 | .000 | .997 |
| Gender | .003 | 1 | .003 | 2.202 | .169 | .180 |
| Error | .014 | 10 | .001 | | | |

The effect of Machine on sweat loss was further investigated by using the pair wise comparison of means. Such comparisons have been shown in Table 4. The means plot is shown in Figure 2.

**Table 4.** Pair wise comparison of marginal means for the data on weight loss

| (I) Machine | (J) Machine | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval for Difference Lower Bound | 95% Confidence Interval for Difference Upper Bound |
|---|---|---|---|---|---|---|
| Treadmill | Bicy Ergo. | .156* | 0.015 | 0.000* | 0.114 | .197* |
| Treadmill | Stepper | .138* | 0.017 | 0.000* | 0.09 | .185* |
| Bicy Ergo. | Stepper | -0.018 | 0.018 | 0.969 | -0.069 | 0.03 |

*Significant at 0.05 level of significance

Means plot in Figure 2 shows that the weight loss is maximum during exercise on treadmill in comparison to that of bicycle ergometer and stepper. However, there was no difference in the sweat loss observed during exercise on bicycle ergometer and stepper.

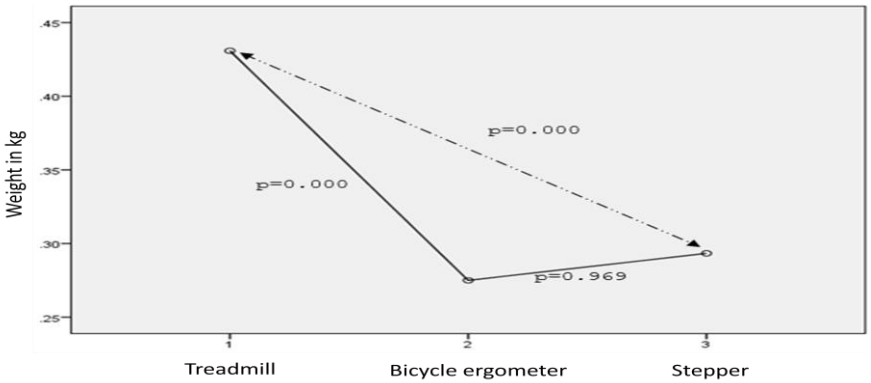


**Fig. 2.** Means plot of sweat loss on three cardio machines (male and female combined)

The findings pertaining to the study clearly revealed that the sweat loss during exercise on treadmill was significantly higher than that of stepper and bicycle ergometer. However, sweat loss during cycling and stepper did not differ significantly. As the workload was kept constant on all the machines the less sweat rate propagates the usage of these machines i.e. stepper and bicycle ergometer for the cardio programme. The earlier study clearly indicates the negative impact of

dehydration on performance and unsafe weight management can compromise other performances and negatively affect health (Turocy et al., 2011). Further the production of sweat is controlled by the body's thermo-regulatory mechanism and trained personnel have shown more sweat production than the untrained person as aerobic training results in enhanced heat dissipation by lowering the core temperature threshold for skin vasodilation and sweating(Ricardo, 2012). Evidence could not be traced out for the relation between sweat loss and fat burning. Some of the earlier studies have shown a high sweat production among males but many of recent studies have rejected this absolute phenomenon and established the effect of fitness and training level as the main causal factor (Mehnert et al. , 2002). Further the rate of sweat production has also been attributed to body surface area, height and weight of the subjects (Pandolf et al., 1986). The present study considered gender as a blocking variable but the effect of block was found to be insignificant. Since the subjects consisted of sedentary population and were under the practise of trainers for a subsequent duration, the fitness level of the subjects could be held responsible for this.

## 4. Conclusion

The present study lead to the conclusion that the reduction of weight due to sweat loss should not be seen as a reflection of amount of fat reduced from the body during exercise. Foreseeing the negative effect of dehydration on other performance the weight management programme should be carefully designed. As of the findings of the present study the cycling and stepper should be preferred over treadmill running as the weight loss due to sweat production was significantly lower than the treadmill.

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