„BABEȘ-BOLYAI” UNIVERSITY
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FACULTY OF PHYSICAL EDUCATION AND SPORT
DOCTORAL SCHOOL OF PHYSICAL EDUCATION AND SPORT

DOCTORAL THESIS

- ABSTRACT -

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Optimizing the resources used in gyms to achieve the correct body posture and increase the quality of life in adult women

THE SUMMARY OF THE DOCTORAL THESIS

Key words: body attitude, posture, physical deficiencies, quality of life, body composition, physical activity, adult women

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Introduction

For health maintanance there should be understood and applied a healthy lifestyle. Many women "who think they are healthy", have posture alterations, deficiencies of varying degrees, struggle with overweight or have an inadequate body composition. The present research is intended to warn women about these health hazards, to provide solutions to reduce or solve them by optimized means and, as a result, to contribute to improving their quality of life.

Quality of life refers to the more or less "good" or "satisfactory" nature of people's lives. Quality of life is a complex concept with multiple sides, although when used in everyday life, it does not meet a unanimous definition of specialists. Although there is no standard definition of the quality of life, it is generally accepted that it is a subjective, multidimensional assessment of the physical, psychological, and social domains of health (Guyatt, Feeny & Patrick, 1993).

A growing cross-sectional database supports a strong relationship between obesity and the quality of life, in which the quality of life appears to decrease with weight gain (Fontaine & Bartlett, 2003; Kolotkin, Meter & Williams, 2001; Kushner & Foster, 2000; Hassan et al., 2003). In general, the literature has argued that even a small weight loss often leads to significant improvements in the quality of life (Fontaine & Barofsky, 2001).

There are few studies that focus on the effects of physical activity on postural control and corrections (Bogdani & Pano, 2016), and research on postural alignments usually evaluates a single segment, such as head and shoulder position (Aitken, 2008; Carneiro, Cardoso, Cunha & Teles, 2014; Raine & Twomey, 1997), curvature and length of thoracic kyphosis and lumbar lordosis (Dunleavy, Mariano, Wiater & Goldberg, 2010; Leroux et al., 2000) or alignment of the spine and pelvis from a lateral view (Roussouly, Gollogly, Berthonnaud & Dimnet, 2005), preventing the comparison of results. Postural studies usually address postural alignments in children and adolescents, and if the subjects are adults the posture is studied related to other pathologies and the presence of pain, and there are but few studies performed on healthy subjects.

Purpose and objectives of the research

We conducted this research in order to investigate the effect of fitness training on body composition and physical deficiencies, and implicitly on the quality of life in adult women.

The general objective of the research is to optimize the health condition, the correct body posture of women as well as to improve their quality of life.

In addition to the general objective, we have proposed some secondary objectives:

- ✓ Evaluation of female clients who attend gyms in Oradea, on body composition, body posture (physical deficiencies) and quality of life.
- ✓ Detection of cases of obesity and overweight.
- ✓ Identifying the age group at which overweight is more common.
- ✓ Detection of visible physical deficiencies.
- ✓ Improving the body composition, the correct body posture of adult women and implicitly the health as well as the quality of life.
- ✓ Evaluating the connection between training programs and the presence of physical deficiencies.
- ✓ The effects of some intervention programs on body composition and physical deficiencies.
- ✓ The effect of workouts in gyms on well-being.
- ✓ Awareness of women on the importance of daily physical activity to increase health and thus the quality of life.

Research hypotheses

In the present research we started from the following hypotheses:

1. Exercising regularly will have the effect of increasing the quality of life.
2. Training programs will have a beneficial effect on body posture, physical deficiencies - by improving or correcting them - and on body composition - by reducing the percentage of adipose tissue.

Part I - The stage of knowledge regarding the researched topic
Chapter 1. Somatic, physiological, psychological and social particuliarities of adult women

This chapter deals with aspects of knowledge, reflected in the literature, on adult women, their physiological, psychological and social characteristics.

1.1. Conceptual delimitations

According to the explanatory dictionary: "woman" is a female adult; a married female person, and the "girl" is a female person, young, child, virgin, unmarried girl.

Young women are between 25-30 years old (the lower limit overlaps over the period from 20 to 24/25 years, also known as the period of prolonged adolescence, being a significant transition to virtual adult status. The upper limit is set at age 35, involving dilation up to age 40). Adult women are between 35-50 years old, but the lower limit overlaps over the period of young adults from 25 to 30 years, and the upper limit expands to 60 years (Bonchiş & Secui, 2004).

The term sex refers to the biological and physiological characteristics that define men and women (WHO, 2009). Sex refers to biological characteristics (external and internal sexual organs, specific hormonal proportions, genetic dowry, etc.), on the basis of which human beings are classified as women or men.

Sex is not confused with gender, which is a concept of social differences (as opposed to biological differences) between women and men, differences that are acquired and are likely to change over time, with significant variations, both within the same culture, as well as in different cultures.

The term "sex" includes the following characteristics: biological, innate, constant, universal ones.

The term "gender" means: social, learned behavior, changes over time, changes within the existing culture and from one culture to another.

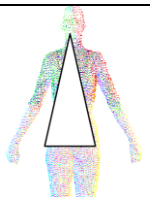
1.2. Biological characteristics of women

1.2.1. Female morphotypes - conformation in women

The most significant contribution to the existence of body classifications was made in the 1930s by the American psychologist William Sheldon. In 1940, Sheldon, together with Stevens and Tucker, introduced the concept of "somatotype" and thus 3 constitutional types were born: endomorphic, mesomorphic and ectomorphic.

The classifications on female morphotypology are quite numerous and are studied by several authors. Because pure types are rare, as in the case of temperaments, most people have typological mixtures, in which one type or another predominates.

Table 1. Summary and grouping of common body shapes

Body shape	Description	Ilustration
Triangle "A" Frame Pear Spoon Christmas Tree	Shoulders narrower than hip. Weight and adipose tissue mainly distributed in buttocks, hips and thighs. The bust is small to medium. Upper body smaller than lower body.	
Inverted Triangle Cone "V" Frame	Shoulders wider than hips, upper body more developed, chest wide. Weight gain in upper body and stomach. Very narrow hips.	
Rectangle "H" Frame	No definition at the waistline. Shoulders and hip about the same width. Equal body proportions.	
Hourglass Figure 8 "X" Frame	Equally broad at the shoulders and hips, but thin at the waist.	
Oval Circle Apple Diamond "O" Frame	Relatively narrow shoulders and hips, chest and abdomen are where weight and fat are stored. Skinny legs.	

When discussing descriptions of different types of bodies, constitutionally, the terms "endomorphic, mesomorphic and ectomorphic" are usually not the most common. Most often, the terms used are divided into 3 categories which indicate names of fruits/vegetables, shapes and, respectively, letters/numbers. Table 1 shows these constitutional types (Simmons, Istook & Devarajan, 2004).

1.2.2. Body composition

Body composition is the relative percentage of adipose tissue and non-fat mass (bones, muscles, internal organs, water, blood) of total body weight. Adipose tissue consists of essential body fat (present in nerve tissue, bone marrow and organs) and non-essential fat (represented by subcutaneous adipose tissue, along the fascia and between muscle bundles, around the kidneys, liver and heart). Essential fat accounts for about 3% of body weight in men and 12% in women. In general, the percentage of total body fat (essential and non-essential fat) is between 12% and 15% for young men and between 25% and 28% for young women. The percentage of adipose tissue varies according to age: in women up to 30 years it is between 14-21%, between 30-50 years it is 15-23%, respectively over 50 years, 16-25% (Jeukendrup & Gleeson, 2010). According to Wilmore, Buskirk, DiGirolamo, and Lohman (1986), the optimal health level of body fat in unsportsmanlike adults is 12-18% (10-25%) for men and 16-25% (18-30%) for women.

1.3. The characteristics of women from a social - economic point of view

The status of women varied considerably from one society to another. Women have had, since antiquity, in the society and political life of European states, a subordinate status and functions.

In most countries, men generally play a productive role (i.e., do activities for which they are paid, considered work), while women have both a productive role and a reproductive (or domestic) role, referred to in the literature as "double burden". This term refers to the tensions between the multiple social roles of women in everyday life, when they have to satisfy the care of the family, housework and work for a salary. Thus, the woman is confronted with the choice between satisfying personal needs and satisfying the needs and desires of those she naturally "cares for": husband, children, parents, and indirectly, generate tensions between paid and unpaid, invisible work (Roman, 2006).

According to the European Commission (2009a), the general situation of women and men in the European Union is described as follows:

- the employment rate of women is increasing but remains lower than that of men, even if the share of women is higher in the total number of students and graduates of university education;
- women continue to have salaries, on average, 17.4% lower than men, for every hour worked and this figure shows no changes;
- women are still very poorly represented in economic and political decision-making positions, even though their share in these areas has increased over the last ten years;

- the distribution of family responsibilities between women and men still remains very uneven;
- the risk of being affected by poverty is higher for women than for men;
- women are the main victims of sexual violence, and women and girls are much more vulnerable to human trafficking.

1.4. Psychological particuliarities of women

Gender stereotypes not only exist in all populations of the planet, but have a quasi-identical content: men are generally considered more aggressive, more self-controlled and colder, more ambitious and competitive, more objective and rational, more independent and dominant, in while women are seen as more tender, more emotional and sensitive to the feelings of others, more caring and less competitive, more religious, more concerned with how they look, more talkative and more dependent; men are inclined towards mathematics and "hard" sciences, and women towards arts (Iluţ, 2006).

Representations about the man, which focus on the tendency of aggression, dominance, reason and initiative, and for women, those of dependence, care for others and expressive needs (emotions, tendency to communicate and the importance of feelings, care for others), have been attested as universal by systematic cross-cultural studies (D'Andre, 1966; Murdock, 1967).

Regarding the functioning of psychic processes, most research has shown that there are no differences in general intelligence, but there are differences between the types of intelligence, which are developed differently in the two sexes, in the sense that men tend to get higher scores on spatial skills tests (mental, two-dimensional, or three-dimensional figure manipulation), while women tend to score higher on tests that measure verbal, social, and emotional intelligence (Geis, Boston & Hoffman, 1985; Simpson & Stroh, 2004).

Chapter 2. Physical activity in adult women

This chapter presents aspects on physical activity in adult women, the benefits of physical activity and their lack, as well as aspects on obesity, reflected in the literature.

2.1. Conceptual delimitations

Physical activity is defined by the WHO (2018) as "any bodily movement produced by skeletal muscles that requires energy expenditure". The general definition includes all contexts of physical activity, namely leisure time activity (dancing, gardening, hiking, swimming),

transport (walking or cycling), occupational, household chores, play, games, a planned sport or exercise, in the context of daily activities, with the family and in the community.

According to the Encyclopedia of Physical Education and Sports (Nicu et.al., 2002), physical activity is defined as "Type of human activity generally characterized by conscious, motivated movements, performed for different purposes, either in professional activity or in sports, tourism, recreation (as an important part of free time)".

For good health, the usual recommendations promote moderate-intensity physical activity for at least 30 minutes each day. This is true for both women and men. However, a very small percentage of women engage in physical activity voluntarily.

In order to improve cardiorespiratory and muscular endurance, bone health, and reduce the risk of noncommunicable diseases and depression, WHO (2010) recommends the following:

- adults between the ages of 18 and 64 to do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or at least 75 minutes of vigorous-intensity aerobic physical activity during the week or an equivalent combination of activity with moderate and vigorous intensity;
- the aerobic activity must be performed for at least 10 minute sequences;
- for additional health benefits, adults should increase moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate activity, and vigorous;
- muscle toning activities should be performed involving large muscle groups in 2 or more days a week.

This recommendation is completed by ACSM (2018) with the following ones:

- 2-3 days a week adults should perform resistance exercises for each of the major muscle groups;
- practicing neuromotor exercises that involve balance, agility and coordination;
- exercises to increase flexibility 2 times / week for each of the major muscle groups.

2.2. The benefits of physical activity

Physical activity, health and the quality of life are closely linked. The human body was designed to move; therefore, it needs regular physical activity for optimal functioning and disease prevention. Sedentary lifestyle has been shown to be a risk factor for the development of many chronic diseases, including cardiovascular disease, one of the leading causes of mortality in the Western world. In addition, an active life brings many other social and psychological benefits and there is a direct link between physical activity and life expectancy, so that active populations tend to live longer than inactive ones (European Commission, 2008).

According to the European Union's Physical Activity Guideline, there is currently sufficient evidence that those who lead a physically active life can achieve a number of health benefits, including:

- reduced risk of cardiovascular disease;
- prevention and/or delay of the development of hypertension and greater control of blood pressure in people suffering from hypertension;
- adequate cardio-pulmonary function;
- maintenance of metabolic functions and a low incidence of type II diabetes;
- accelerating fat burning, which can be useful in weight control, reducing the risk of obesity;
- reducing the risk of certain types of cancer, such as breast and colon cancer;
- increase bone mineralization at an early age, contribute to the prevention of osteoporosis and fractures in old age;
- improving digestion and regulating intestinal transit;
- maintaining and improving muscle strength and endurance, which strengthens the functional capacity to perform daily activities;
- maintaining motor functions, including strength and balance;
- maintaining cognitive functions and reducing the risk of depression and dementia;
- decreasing the level of stress and, associated with this decrease, improving the quality of sleep;
- improving self-image and self-confidence and increasing enthusiasm and optimism;
- decrease the level of medical leave at work;
- at a very advanced age, reducing the risk of falls and preventing or delaying the onset of chronic diseases associated with aging.

2.3. The level of physical activity in women, lack of physical activity and obesity

According to WHO (2009), 6% of deaths worldwide are caused by physical inactivity, which is considered an important risk factor. The overall prevalence of insufficient physical activity was 27.5% in 2016, and women are more inactive than men: 31.7% compared to 23.4% (Guthold, Stevens, Riley & Bull, 2018; WHO, 2019) .

The World Health Organization (2018) states that globally 1 in 4 adults is not active enough and in most countries, girls and women, older adults, disadvantaged groups and people with disabilities all have fewer opportunities to access physical activity programs. WHO member states have agreed to reduce physical inactivity by 10% by 2025.

Overweight and obesity are responsible for 8% of global mortality, according to the Global Burden of Disease study, 4.7 million people died prematurely in 2017 as a result of obesity (GBD Risk Factor Collaborators, 2017).

Research by Sport England (2015, 2016) shows that in the UK, women are less active than men (31.9% do sports at least once a week, compared to 40.5% for men), and 13 million of women and girls say they would do more sports and physical activity.

Physical activity levels tend to decrease with increasing age (Hawkins et al., 2009; Jones et al., 1998) and women tend to be less active than men (Jones et al. 1998; Marshall et al., 2007).

2.2.1. The global obesity situation

Data published by WHO (2016) and the International Association for the Study of Obesity (IASO) suggest that the number of obese people worldwide tripled between 1975 and 2016 and led to a prevalence of 650 million obese and 1.9 billion people overweight living in the world.

According to the WHO in 2016, 39% of adults over the age of 18 were overweight. Overall, approximately 13% of the world's adult population (11% of men and 15% of women) were obese (WHO, 2016).

2.2.2. The situation of overweight and obesity in Romania

The prevalence of obesity in adults is relatively low in Romania; according to the latest data EHIS 2014 (European Health Interview Survey, Eurostat), it is 9.1%, but it was 8% in 2008. For now it is the lowest in the EU28, on the other hand, the prevalence of overweight in Romania (44.8%) is the highest in the EU28, and the general trend is one of worsening situation.

According to World Obesity data, in Romania 26.4% of women (20-79 years old) were overweight, and 34.1% of women (20-79 years old) were obese. This survey in Romania was conducted in 2012-2014, an epidemiological study with a stratified, cross-sectional, random sampling, including 2681 subjects (Popa et al., 2016).

According to the WHO in Romania in 2016, the prevalence of overweight among adults was 57.7%, in men 64.3%, in women 51.1%, and the prevalence of obesity in adults was 22.5%: in men 23.4%, in women 21.6%.

2.3. Types of physical activities performed by women at the gym

Ladies frequent the spaces designated for sports activities to lose weight, to keep fit, to be beautiful and healthy. Women prefer group aerobics classes: step aerobics, tae-bo, kangoo-jumps, zumba, etc., or relaxation and stretching classes: yoga, Pilates, body art, etc.

Obstacles caused by various factors can arise in the management and promotion of women's physical activities. According to Sport England (2015) among the possible obstacles can be:

- lack of time - many women juggle raising children, housework, jobs and can't find time for them;
- lack of motivation - some women say they do not feel motivated without a training partner. Others believe that in order to be effective, exercise must be painful and exhausting (which is not true);
- parenting requests - many women fulfill more caring responsibilities, including for children and older relatives, and take responsibility for preparing meals and cleaning the house;
- lack of energy - fatigue is caused by a busy lifestyle, working mothers are often tired;
- health status - older women are more likely to have a chronic health condition (eg arthritis), which limits their participation in some forms of exercise;
- lack of money - low-income women are less likely to exercise regularly. This can be real, because they believe that any physical activity requires expensive equipment and expensive clothes (nothing more wrong);
- because of stereotypes - many women believe that housework and raising children are "women's work", and then they do not allocate time for exercise (perhaps because they feel guilty about taking time for themselves);
- fear of being judged: either for their physical appearance, or for their appearance, etc.
- lack of information: they don't know where and how to start, there is the challenge of finding the right activity at the right time.

2.3.1. Pilates

The method invented by the German Joseph Pilates, who called it "Contrology", encourages the use of the mind to control the muscles. It emphasizes the muscles that control posture and keeps the body in balance by supporting the spine. The exercises are based in particular on awareness of breathing, alignment of the spine, strengthening the muscles of the trunk and abdomen.

Pilates is a system of physical exercises that work the whole body, from the deepest muscles to the peripheral muscles, exercises that involve both the mind and the body and breathing.

The basic principles of the Pilates method (St. John, 2007) are: precision, centering, fluency / rhythm, concentration, breathing, control, balanced muscle development, relaxation.

The Pilates method refers to strengthening and balancing the muscles in the abdomen, lumbar spine, buttocks and thighs to create the "center of force" of the body. Muscle balance is achieved by strengthening weakened muscles and relaxing contracted muscles. This increases control, strength and flexibility of the body, protecting the joints and back.

In Pilates, slow, controlled movements are used - quality matters, not quantity.

2.3.1.2. The Pilates method in the literature

In the last decade and a half, there has been a growing body of literature published in medical journals advocating the use of the Pilates method as an effective form of conservative treatment for the rehabilitation of injuries in the field of physiotherapy. Pilates has been shown to improve core endurance (Emery, De Serres, McMillan & Cote, 2010; Kloubec, 2010), to increase muscle endurance and overall flexibility (Campos de Oliveira, Goncalves de Oliveria & Pires-Oliveria, 2015; Kao, Liou, Huang, Tsai & Wang, 2015; Kloubec, 2010; Segal, Hein & Basford, 2004; Sekendiz, Altun, Korkusuz & Akin, 2007), increase efficient movement (Emery et al., 2010; Herrington & Davies, 2005), to improve posture and postural balance (Alves de Araujo et al., 2012; Campos de Oliveira et al., 2015; Emery et al., 2010; Natour et al. 2015), it helps manage pain, it relieves pain and restores physical functionality (Campos de Oliveira et al., 2015; Rydeard, Leger & Smith, 2006; Wells, Kolt, Marshall, Hill & Bialocerkowski, 2014) and, implicitly, it increases the quality of life (Campos de Oliveira et al., 2015; Vieira et al., 2013).

A systematic review of the literature in 2018, by Byrnes, Wu & Whillier found the following results: of 23 studies published between 2005-2016, which evaluated the effectiveness of Pilates in the rehabilitation of low back pain, ankylosing spondylitis, multiple sclerosis, post-menopause osteoporosis, unstructural scoliosis, high blood pressure and chronic pain in the cervical area, 19 studies found that Pilates is more effective than the control group in improving health, especially in reducing pain and increasing functionality.

Chapter 3. Aspects regarding body attitude and physical deficiencies in adult women

This chapter presents the reflection in the specialized literature of the aspects regarding the body attitude, posture and physical deficiencies in adult women and presents the global and segmentar somatoscopic examination.

3.1. Body attitude - conceptual delimitations

The Encyclopedic Dictionary defines attitude as:

- body posture or position;
- way of behaving towards an event or aspect of reality;
- predisposition of the person to react in a certain way to the most diverse life situations, with a function of orientation and evaluation of behavior.

Sbenghe (1999) defines bodily attitude as "the physical activity that maintains the position of a body, its relationship with the environment and the relationship between body components (segments)."

Attitude is a “position of the body and its segments, present both statically and during movements, provided by the cortical and subcortical motor centers, based on complex proprioceptive, vestibular, visual and auditory information. Physical activities contribute to the formation of a correct attitude” (Nicu, 2002).

Due to the fact that the term "attitude" has several meanings, it tends to be replaced in the literature with that of "posture".

Posture has proven to be a tool in both expressing and recognizing emotions, and body language portrayed through a posture can serve as a rich source of information that can reveal the goals, intentions, and emotions of others (Kana & Travers, 2011).

The word posture is of French origin - posture -, and means the relative disposition of the segments, especially the position of the limbs or the body as a whole, which indicates a certain feeling, position or attitude (Gilman, 2014).

Posture is a function of the musculoskeletal system directed by the nervous system and represents the infinity of positions and movements that permanently double the mental activity of the individual.

3.2. Correct body posture

The correct posture of the body is a sign of the psycho-physical balance of the individual. According to Bratu (1977), "the postural system is a “unitary structure” with multiple inputs and having several complementary functions: to fight against gravity by maintaining an erected station; to oppose external forces; to place the individual in space and time; to balance the body in movements, to guide and strengthen them."

In the realization of the posture, there participate: passive elements (bones, joints, etc.); active elements (neuro-muscular system), maintaining together postural homeostasis, stability, balance and constant relationships between the body and its segments and between the body and the external environment.

According to Bratu (1977), posture is conditioned by hereditary predispositions that are manifested by: constitutional characteristics, the degree of muscle tone, the sex and it depends on

other factors such as health, age, body weight, character of professional and habitual skills and the individual's concerns for forming and maintaining a correct posture.

According to Kendall, McCreary, Provance, Rogers & Romani (2005), posture is a compound made up of the positions of all body joints at a time, and static postural alignment is best described by the positions of different joints and body segments. As with all assessments, there must be a standard for assessing postural alignment. The ideal, or standard, skeletal alignment involves a minimal amount of stress and strain and leads to maximum body efficiency.

3.3. Physical deficiencies

Physical deficiencies are characterized by pathological changes; they occur primarily in the shape and structure of the body and are manifested by a slowdown or excessive growth, by a disharmonious or disproportionate development, by deviations, deformations or other morphological defects. Deficiencies can be global or partial; somatic, organic or psychic; light, medium or accentuated.

3.5. Incidence of physical deficiencies in adult women

The most common physical deficiencies in adults occur in the spine (Adult Spinal Deformity - ASD). These spinal deformities seen in adults can lead to severe medical, psychological and social disorders due to severe back pain and neurological symptoms, and can affect daily activities and the quality of life.

The most common deformities of the spine in adults are: scoliosis and kyphosis (Diebo et.al., 2019; Katzman, Wanek, Shepherd & Sellmeyer, 2010).

The prevalence of spinal deformity and scoliosis in adults is not well established, as estimates range from 8.85% to 68%. Studies generally examine and include elderly subjects over the age of 60; there can be observed the increase of the rate of deformities of the spine with the advancing age.

The incidence of spinal deformities in adults, especially scoliosis and kyphosis, is more common in women than in men (Barreto et.al., 2015; Chen, Kim, Allan-Blitz & Shamie in 2016; Kebaish, Neubauer, Voros, Khoshnevisan & Skolasky, 2011; Naresh-Babu, Viswanadha, Ito & Park, 2019).

We did not find data on spine deformities in adults in Romania, but if we accept these estimates as comparable to the Romanian population, the number of patients with spinal deviations, scoliosis and kyphosis, in adults should increase with increasing life expectancy and increasing number of people over 65 years.

3.6. The effect of physical activity on body attitude and physical deficiencies

Treatment of incorrect body posture and physical deficiencies may include medication (analgesics, injections), orthopedics (corset), surgery and kinetics, depending on their severity, whether it is a functional or pathological deviation. Physiotherapeutic, kinetic treatment through exercise should be essential, as many of the causes of deficiencies are mainly of musculoskeletal origin.

In the treatment of kyphosis, it is generally accepted that increasing the strength of the trunk extensor muscles reduces kyphosis, which is also scientifically proven (Benedetti, Berti, Presti, Frizziero & Giannini, 2008; Itoi & Sinaki, 1994; Katzman et.al., 2010 ; Katzman, Sellmeyer, Stewart, Wanek & Hamel, 2007). But a review of the literature in 2014 by Bansal, Katzman & Giangregorio highlighted the lack of treatment protocol, guidelines and evidence-based treatments for treating kyphosis in adults (over 45 years).

Yoga can reduce thoracic hyperkyphosis in older adults (Greendale, Huang, Karlamangla, Seeger & Crawford, 2009).

Historically, scoliosis treatment has consisted of Scoliosis Specific Exercises (SSE) (15-25 ° Cobb), orthopedic treatment, corset (20-40 ° Cobb), and spinal fusion surgery (> 40-50 ° Cobb). (Roaf, 1980). Conservative treatment of neuromuscular scoliosis should include an exercise program as an adjunct to an orthosis (Bayar, B., Uygur, Bayar, K., Bek & Yakut, 2004).

Physiotherapeutic Scoliosis-Specific Exercises (PSSE) are widely used and widely recognized scoliosis rehabilitation techniques in several Central European countries; these include: the Schroth method - German; Barcelona Scoliosis Physical Therapy School (BSPTS); the SEAS approach (Scientific Exercise Approach to Scoliosis); Dobomed method; FITS (Functional Individual Therapy of Scoliosis); the Lyon method and Min Mehta's "Side-shift" exercises (Berdishevsky et.al., 2016).

However, there are studies and evidence that other physical activities can improve the Cobb angle in scoliosis. A study by Kim & HwangBo in 2016 compared the Schrott and Pilates method in reducing the Cobb angle in patients with idiopathic scoliosis and concluded that both Schroth and Pilates exercises were effective in changing the Cobb angle, as the intragroup comparison showed significant effects for both groups; however, the comparison between the groups showed that the Schroth method was more effective than the Pilates method.

Chapter 4. Quality of life issues

Chapter 4 presents aspects regarding the quality of life, tools for evaluating the quality of life and the reflection on the topic in the specialized literature.

4.1. Conceptual delimitations

Being a complex concept, with multiple sides, although used in everyday life, the term quality of life does not meet a unanimous definition of specialists. Although there is no standard definition of the quality of life, it is generally accepted that this is a subjective, multidimensional assessment of the physical, psychological, and social domains of health (Guyatt, Feeny & Patrick, 1993).

The World Health Organization (WHO, 1998) defines quality of life as "the perceptions of individuals on their social situations, in the context of the cultural value systems in which they live and depending on their own needs, standards and aspirations."

4.3. Reflecting on the quality of life in literature

A systematic review of the level of physical activity and health-related quality of life in the adult population shows that physical activity has a positive influence on the quality of life (Bize, 2007).

The 2016 European Quality of Life Survey shows that participation in sports or exercises increases life satisfaction and regular exercise has been shown to be associated with greater subjective well-being (Eurofound, 2017).

A higher level of physical activity and less time spent in sedentary behavior are associated with an increased health-related quality of life among the general population of children and adolescents (Wu et al., 2017). Also, in adults able to work, the highest levels of the quality of life and its four areas (physical, psychological, social and environmental) were found among the most physically active respondents (Puciato et al., 2018).

A growing cross-sectional database supports a strong relationship between obesity and the quality of life, in which the quality of life appears to decrease with weight gain (Fontaine & Bartlett, 2003; Kolotkin, Meter & Williams, 2001; Kushner & Foster, 2000; Hassan, Joshi, Madhavan & Amonkar, 2003). In general, the literature has argued that even a small weight loss often leads to significant improvements in the quality of life (Fontaine & Barofsky, 2001).

Numerous studies show that regular practice of different types of physical activity (sports, Pilates, interval training, circuit, endurance, Nordic walking, etc.) in different populations and age groups (children and adolescents, adults, women, the elderly), healthy or with various diseases, lead to an increased quality of life, both its physical and mental components (Ballin, et al., 2019; Bashkireva et al., 2018; Brown et al., 2004; Marcos-Pardo et al. al., 2019; Omorou, Erpelding, Escalon & Vuillemin, 2013; Puciato, Rozpara & Borysiuk, 2018; Vieira, Faria, Wittmann, Teixeira & Nogueira, 2013; Wu et al., 2017).

Conclusions on the first part

From the analysis of the specialized literature, related to the researched topic, we find the following:

- the overall prevalence of insufficient physical activity was 27.5% in 2016, and women are more inactive than men: 31.7% compared to 23.4% (Guthold, Stevens, Riley & Bull, 2018; WHO, 2019)
- obesity is constantly increasing, in 2016 there were 650 million obese and 1.9 billion overweight people in the world (WHO, 2016);
- the World Health Organization (2018) states that globally 1 in 4 adults is not active enough and in most countries, girls and women have fewer opportunities to access physical activity programs;
- the main factors for which women do not do physical activity are: fear of being judged (by men; by other women, by those who are better in sports; mothers feel guilty, if they are far from children, etc.), practical barriers (lack of time, money, information, etc.) and personal barriers (they worry about their behavior, they are ashamed, their self-confidence is low, etc.);
- levels of physical activity tend to decrease with increasing age (Hawkins et al., 2009; Jones et al., 1998) and women tend to be less active than men (Jones et al. 1998; Marshall et al., 2007);
- the prevalence of overweight and obese people tends to decrease as the level of education increases (Eurostat, 2014);
- the most common physical deficiencies in adults occur in the spine (ASD - Adult Spinal Deformity) and the most common deformities of the spine in adults are: scoliosis and kyphosis (Diebo et.al., 2019; Katzman, Wanek, Shepherd & Sellmeyer, 2010);
- there can be observed the increase of the rate of deformities of the spine with the advancing age;
- the incidence of spinal deformities in adults, especially scoliosis and kyphosis is more common in women than in men (Barreto et.al., 2015; Chen, Kim, Allan-Blitz & Shamie in 2016; Kebaish, Neubauer, Voros, Khoshnevisan & Skolasky, 2011; Naresh-Babu, Viswanadha, Ito & Park, 2019);
- physical activity has a positive influence on the quality of life (Bize, 2007);
- participation in sports or exercises increases life satisfaction and regular exercise has been shown to be associated with greater subjective well-being (Eurofound, 2017);

- in adults able to work, the highest levels of the quality of life and its four areas (physical, psychological, social and environmental) were found among the most physically active respondents (Puciato et al., 2018);
- in general, the literature has argued that even a small weight loss often leads to significant improvements in the quality of life (Fontaine & Barofsky, 2001);
- Pilates has been shown to improve core endurance (Emery, De Serres, McMillan & Cote, 2010; Kloubec, 2010), posture and postural balance (Alves de Araujo et al., 2012; Campos de Oliveira et al., 2015; Emery et al., 2010; Natour et al. 2015), it helps manage pain, it relieves pain and restores physical functionality (Campos de Oliveira et al., 2015; Rydeard, Leger & Smith, 2006; Wells, Kolt, Marshall, Hill & Bialocerkowski, 2014) and, implicitly, it increases the quality of life (Campos de Oliveira et al., 2015; Vieira et al., 2013);
- in relation to health, the quality of life is a particularly important concern among women. They constantly complain of worse health than men (Marks, 2003).

Part II - Preliminary research on the working protocols and measuring instruments used

Chapter 5. Verification of tools for the study of body composition, body attitude, physical deficiencies and the quality of life in adult women

5.1. Purpose

The aim of this research was to design a work protocol as effective as possible and to check the tools for assessing body composition, body attitude, physical deficiencies and the quality of life in adult women who attend gyms. At the same time, we wanted to see the prevalence of overweight, obesity and the presence of physical deficiencies in women who attend gyms.

5.2. Objectives

We set the following objectives:

- checking the evaluation tools regarding the body composition, posture and quality of life that we can use in the final research;
- construction and verification of the necessary files for data collection;
- designing an efficient working methodology;
- measuring the time needed to evaluate a subject regarding body composition, posture and quality of life;

- detecting cases of overweight and obesity;
- detection of physical deficiencies.

5.3.Materials and methods

5.3.1. Subjects

This study involved 24 adult women, who attended the Fit4U Fitness Center in Oradea. Study period: December 2014 - January 2015. The research included only those women who showed interest, accepted the measurements and gave their consent for using their data in the research.

5.3.2. Anthropometric measurements

Anthropometric measurements were performed according to the standards described by ISAK - International Society for the Advancement of Kinanthropometry:

- height (in cm);

- weight (expressed in kg, using a calibrated scale);

- the circumferences (expressed in cm, with metric tape) at the following areas: neck, chest, arm, waist, hips, thigh, calfs;

- skinfolds (expressed in mm, with Slim Guide caliper): only on the right side of the body, 3 times in each region and using the average value in the following 5 regions: brachial biceps, subscapularis, abdominal, supraspinal (or flank), thigh .

The evaluation form of the anthropometric examination can be followed in annex no.1.

5.3.4. Global and segmental somatoscopic examination

The global and segmental somatoscopic examination was performed in the three planes: the anterior frontal plane, the posterior frontal plane and the sagittal plane; the somatoscopic evaluation form can be followed in annex no.2.

We looked at the following aspects:

- position of the head and neck: if they are on the same vertical line as the torso; if there are anterior or lateral inclinations;

- position of the shoulders and upper limbs: it is noted the lateral or posterior inclinations of the shoulders; the degree of asymmetry of the shoulders or upper limbs;

- position of the spine: the appearance of curves in all planes;

- position of the pelvis: if it is inclined laterally, in anteversion/retroversion;

- position of the lower limbs: the possibility of knees in varus or valgus; plantar arch.

For the confirmation, storage and subsequent analysis of the data of the global and segmental somatoscopic examination, there was performed the evaluation by photo images at the

anthropometric frame, in the three planes: the anterior frontal plane, the posterior frontal and the sagittal plane.

5.3.6. Testing the strength and endurance of core muscles

We used the functional test "Core muscle strength and stability test" after Mackenzie (2002, 2005). Tong, Wu & Nie in 2014 evaluated the validity and reliability of the test in assessing the overall function of the core muscles, the nucleus. They suggest that the core muscle strength and stability test is a valid, reliable one and is a practical method for assessing nuclear muscle endurance in athletes, especially if a test to familiarize with the test takes place before the measurement.

The objective of the test is to monitor the development of the abdominal and lumbar muscles of the subjects. To perform the test we needed a flat non-slip surface, a mattress, a stopwatch. The test includes 8 stages, in each stage the subject must maintain certain positions for a predetermined time.

5.3.7. Working methodology

During January 2015, the measurements were performed by a single examiner, without the help of other examiners.

The measurements were performed in the morning, before the training of the subjects.

The evaluation started with a short anamnesis (annex no. 4): name, age, occupation/profession, sports history, some important health data and the SF-36 quality of life questionnaire was completed. The measurement of stature (height) and body weight were performed, followed by the measurement of the perimeters and of the skinfolds. The anthropometric evaluation was followed by the somatoscopic evaluation, after which the subjects were photographed at the posture frame. The photo was taken at a distance of 2 m from the anthropometric frame. At the end, the stability and core strength test was performed.

The data obtained after completing the questionnaire on the quality of life SF-36 and the measurements performed, were statistically processed with the SPSS program, using descriptive analysis.

5.5. Discussions

According to BMI, 20.83% (5 subjects) were overweight and no subject was in the obese category, instead according to the body adiposity index (BAI), 33.33% (8 subjects) were overweight and 8.33% (2 subjects), obese.

The waist circumference, as an abdominal fat index, at 3 subjects (12.5%) was increased (over 80 cm), and in 1 subject (4.17%) it was substantially increased, over 88 cm. The World

Health Organization recognizes that the waist circumference between 80.0-87.9 cm in women, and the waist-hip ratio 0.8 in women, is corresponding to the BMI overweight of 25-29.9 kg/m2 (WHO, 2000a, b). Above the threshold of 80 cm there is an increased risk of developing cardiovascular disease, diabetes (WHO, 2008).

According to the waist-hip ratio, no subject was above 0.8, had no increased health risk.

Regarding the global attitude of the subjects: only 20.83% (5 subjects) had a normal attitude, 79.17% (19 subjects) had a deficient global body attitude (scoliotic, lordotic, kypho-lordotic), and at segmental somatoscopic evaluation at evaluation of the vertebral column showed that even more have deficiencies: only 8.33% (2 subjects) did not show any deviation or showed a minor deviation of the vertebral column, 91.67% (22 subjects) had a deformity of the spine .

We managed to prepare and verify the necessary sheets for data collection and we designed the working methodology. Completing the worksheets and fully evaluating a subject took too long, it took an average of 45 minutes.

5.6. Conclusions

The prevalence of overweight and obesity according to BMI is 20.83%, and according to BAI it is exactly double: 41.67%. Due to this discrepancy regarding body fat, we suggest that for the final research to perform a more complex and complete analysis of the subjects regarding body fat, to make correlations with the body fat percentage, determined by measuring skinfolds and to compare the BAI, waist circumference and waist-to-hip ratio with BMI in assessing the percentage of body fat in adult women.

Based on the findings of the global and segmental somatoscopic assessment, we conclude that healthy, physically fit women who attend gyms have posture defects and various types of deficiencies. We propose the implementation of a physical exercise program to improve, correct the overall postural attitude and to reduce physical deficiencies.

All the proposed objectives were met, we managed to verify the assessment tools on body composition, posture and the quality of life that we can use in the final research.

For the final research in order to shorten the complete evaluation of a subject to 25-30 minutes, we suggest organizing an "evaluation circuit": until the anthropometric and somatoscopic measurements are made in some subjects by the examiner, the others to complete individually the quality of life questionnaire and the assessment sheet (anamnesis).

Based on the findings of the preliminary research (high prevalence of physical deficiencies and cases of overweight and obesity) we suggest that at the final research to implement a combined training program, with exercises to improve posture and reduce physical

deficiencies (Pilates), with exercises aimed to improve body composition and weight loss (Step-aerobics, HIIT, gym); at least 3 times a week.

Part III - Research on optimizing the recources used in gyms to achieve the correct body posture and increase the quality of life in adult women

Chapter 6. Study I - Relevance of anthropometric indicators in assessing adiposity in adult women

Introduction

The body mass index (BMI), used to predict body fat percentage for almost 200 years, is not linearly associated with body fat percentage (Gallagher, Heymsfield, Heo, Jebb, Murgatroyd & Sakamoto, 2000). It provides us information about increasing body weight, it allows comparison of body weights and identifies individuals or groups at increased risk of morbidity and mortality (Gupta & Kapoor, 2014). However, the accuracy of BMI in assessing body fatness is still being discussed. Widely used as a measure of adiposity, in fact, BMI is a measure of excess weight relative to height, rather than excess body fat. However, it does not differentiate between a person's fat mass and lean mass, and the distribution of body fat cannot be assessed by it.

Although BMI has traditionally been the chosen method by which to measure body size in epidemiological studies, alternative measures – such as body adiposity index (BAI) (Bergman et al., 2011), waist circumference (Wei, Gaskill, Haffner & Stern 1997; Welborn & Dhaliwal, 2007) and the waist-to-hip ratio (Bigaard et al., 2005; Janssen, Katzmarzyk & Ross, 2004), – were considered to be superior in predicting the risk of cardiovascular disease.

Bergman et al. (2011), in order to counteract some limits of BMI, proposed the introduction of a new way to calculate the percentage of body fat, namely the body adiposity index (BAI). It can be calculated solely from anthropometric measurements – hip circumference and height of subjects (hip circumference / height$^{1.5}$ - 18) – and can be used to reflect the percentage of body fat in adults. The use of BAI has several advantages over BMI, including that it produces associations with body fat percentage and may be easier to assess in field studies because it does not require a weight measurement (Appelhans et al., 2012).

6.1. Purpose

The aim of the study was to evaluate the effect of physical activity on body composition in adult women, who attend gyms and to carry out an analysis of the effect of physical activities on anthropometric indicators of body fat, highlighting the relevance and relationships between

these indicators and the percentage of body fat in adult women. The anthropometric indicators used in the study were BMI, BAI, waist circumference, waist-hip ratio and body fat percentage.

6.2. Objectives

We set the following objectives:

- evaluation of subjects regarding body fat;
- evaluation of the body composition of adult women;
- identifying the effect of the intervention program on adipose tissue and lean mass;
- detecting cases of obesity and overweight;
- statistical analysis of anthropometric indicators: comparison of averages and determination of relationships between them;
- discussing the results.

6.3. Hypothesis

In this study we started from the following hypotheses:

1. There may be significant correlations between the anthropometric indicators used to assess adiposity and body fat percentage.
2. The effects of the intervention program are different depending on the age range.

6.4. Materials and methods

6.4.1. Subjects

This study involved 95 adult women, who practiced physical activities in two gyms in Oradea, for 12 months, between February 2015 and June 2016. The research included only those women who showed interest, accepted the measurements and agreed to use their data in the research.

6.4.2. Methods

Anthropometric measurements were performed: height, weight, circumferences and skinfold thikness. Body composition was calculated based on the measurement of skinfolds, body mass index, adiposity index and waist-to-hip ratio were also calculated.

The body adiposity index (BAI) was calculated according to the formula:

BAI = hip circumference / (height$^{1.5}$) - 18

The data obtained were statistically analyzed with the IBM SPSS program, version 23 (descriptive analysis, comparison of means and correlations).

6.4.3. Applied physical activity program

Following the new recommendations of the ACSM (2018) on performing physical activities in adults aged 18-64, in addition to aerobic physical activities of moderate intensity (150 minutes/week) or vigorous (75 minutes/week) and muscle toning (2 times/week), there were endurance exercises 2-3 times/week, exercises to increase flexibility 2 times/week and the practice of neuromotor exercises, which involve balance, agility and coordination, are also recommended. Our physical activity program was in line with these recommendations, being a combined program: aerobic physical activities of moderate or vigorous intensity were completed by step-aerobic classes and High Intensity Interval Training (HIIT), muscle toning and resistance exercises were performed for major muscle groups, and exercises to increase flexibility, balance, agility and coordination were addressed in Pilates classes.

The physical activity program consisted in combined training of Pilates, Step - aerobics and strength training in the gym, 3 times a week for 60-90 minutes, for 12 months. The weekly division was as follows: 2 Pilates sessions of 60 minutes each, followed by 30 minutes of toning in the gym and 1 step-aerobics session/week of 60 minutes, followed by 30 minutes in the gym .

The summary of the training program can be followed in Table no.15.

Table 2. Summary of the physical activity program

Weeks	Pilates	Step-aerobic	Toning in the gym
1 - 12 (3 months)	Mat 1 - beginners (exercise program no.1-4)	Beginner level Basic steps (program no.1-2)	Beginner level program no. 1-8 HIIT program no. 1-2
13 - 28 (4 months)	Mat 1-2 - beginners/intermediate (exercise program no.5-10)	Intermediate level (program no.3-4)	Intermediate level Program no. 9-16 HIIT program no. 3-4
29 - 48 (5 months)	Mat 2-3 - intermediate/advanced (exercise program no.11-18)	Advanced level Complex choreographies (program no.5-6)	Advanced level Program no. 17-24 HIIT program no. 5-6

6.5. Results

The analysis of the data of the subjects participating in the study reveals that their average age was 28.45 (8.75) years, the minimum age being 18 years, and the maximum 52 years. The descriptive analysis, by age range, is presented in Table 16. Of the 95 subjects, 41 (43.2%) were under the age of 25 years, 31 (32.6%) in the age range of 25-34 years, 14 (14.7%) in that of 35-44 years, and 9 (.5%) were over 44 years.

Table 3. Distribution of subjects according to age range (N = 95)

Age Interval	Frequency	Percent	Valid Percent	Cumulative Percent	Minim	Maxim	Mean	StDev
<25	41	43,2	43,2	43,2	18	24	21,10	1,828
25-34	31	32,6	32,6	75,8	25	34	28,42	2,527
35-44	14	14,7	14,7	90,5	35	43	37,79	2,887
>44	9	9,5	9,5	100,0	45	52	47,56	2,068
Total	95	100,0	100,0		18	52	28,45	8,746

Tabel 4. Descriptive analysis and comparison of means after initial (T1) and final (T2) tests

	Descriptive analysis						**Test Statistics[a]**		**Effect size**
	Test	N	Mean	St dev	Min	Max	Z	p	R
Weight (kg)	T1	95	63,67	11,699	43	103	-5,578[b]	.000	-0.404
	T2	95	62,39	10,634	43	98			
BMI (kg/m^2)	T1	95	22,87	3,96	16,61	36,49	-5,729	.000	-0.416
	T2	95	22,40	3,61	16,96	34,72			
BAI	T1	95	32,55	4,59777	23,10	46,29	-6,298[b]	.000	-0.456
	T2	95	31,79	4,11807	23,33	44,35			
BF %	T1	95	25,63	6,53	16,22	45	-7,583[b]	.000	-0.550
	T2	95	22,97	5,628	13	39			
Real BF (kg)	T1	95	16,95	7,61	8,33	45,90	-7,960[b]	.000	-0.580
	T2	95	14,79	6,26	7,09	38,33			
Lean mass (kg)	T1	95	46,71	5,20	34,58	64,57	-6,165[b]	.000	-0.450
	T2	95	47,66	5,51	34,58	64,57			
Sum of skinfolds (mm)	T1	95	120,83	42,90	58	247	-8,102[b]	.000	0.600
	T2	95	103,04	36,48	40	208			
Neck girth (cm)	T1	95	31,89	2,13	28	41	-6,425[b]	.000	-0.466
	T2	95	31,27	1,92	28	40			
Right arm girth (cm)	T1	95	28,41	3,81	22,5	43	-5,731[b]	.000	-0.415
	T2	95	27,66	3,65	23	41			
Left arm girth (cm)	T1	95	28,32	3,68	23	42	-5,398[b]	.000	-0.391
	T2	95	27.57	3,57	23	41			
Chest girth (cm)	T1	95	76,71	8,17	60	101	-3,786[b]	.000	-0.274
	T2	95	76,03	7,86	60	98			
Hip girth (cm)	T1	95	107,16	7,694	90	130	-6,218[b]	.000	-0.451
	T2	95	108,82	9,027	90	140			
Waist girth (cm)	T1	95	73,13	9,625	58	104	-5,283[b]	.000	-0.383
	T2	95	72,16	8,915	59	99			
WHR	T1	95	,6705	,04884	,58	,83	-1,789[b]	.074	-0.130
	T2	95	,6722	,05056	,58	,83			
Right thigh girth (cm)	T1	95	56,42	5,95	31,5	75	-4,879[b]	.000	-0.353
	T2	95	55,73	5,58	31	72			
Left thigh girth (cm)	T1	95	56,13	5,86	31	72	-3,472[b]	.001	-0.251
	T2	95	55,57	5,54	31	71			
Right calf girth (cm)	T1	95	36,80	3,96	31	59	-3,558[b]	.000	-0.258
	T2	95	36,47	3,83	31	58			
Left calf girth (cm)	T1	95	36,83	3,97	31	59	-3,904[b]	.000	-0.283
	T2	95	36,47	3,76	31	58			

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

The comparison of pre- and post-program means was done using the Wilcoxon nonparametric test. According to the data presented in Table no.18, the difference is significant for all pairs of variables, and the effect size (r) is an average (eg at BMI Z=-5.729, df=95,

p=.000, r=- 0.416; at BF% Z=-7.583, p=.000, r=-0.550), except for the waist-hip ratio, where the difference is insignificant (Z=-1,789, p=.074, df=95, r=-0.130).

At the initial assessment of BMI, 65 subjects (68.4%) were in the normal weight category, 19 of the subjects (20%) were overweight, 6 subjects (6.3%) were underweight, 4 subjects (4.2%) have class I obesity and 1 subject (1.1%) class II obesity. At the final evaluation 69 subjects (72.6%) had normal weight, 15 of the subjects (15.8%) were overweight, 7 subjects (7.4%) were underweight, 4 subjects (4.2%) were obese class I and no subjects with class II obesity (Table 19).

Table 5. Frequency of overweight and obesity by index and test time (N=95)

			Frequency	Percent	Valid Percent	Cumulative Percent
BMI	T1	Underweight	6	6,3	6,3	6,3
		Normal weight	65	68,4	68,4	74,7
		Overweight	19	20	20	94,7
		Class I obesity	4	4,2	4,2	98,9
		Class II obesity	1	1,1	1,1	100,0
		Total	95	100,0	100,0	
	T2	Underweight	7	7,4	7,4	7,4
		Normal weight	69	72,6	72,6	80,0
		Overweight	15	15,8	15,8	95,8
		Class I obesity	4	4,2	4,2	100,0
		Total	95	100,0	100,0	
BAI (Body Adiposity Index)	T1	Healthy	61	64,2	64,2	64,2
		Overweight	27	28,4	28,4	92,6
		Obese	7	7,4	7,4	100,0
		Total	95	100,0	100,0	
	T2	Healthy	67	70,5	70,5	70,5
		Overweight	22	23,2	23,2	93,7
		Obese	6	6,3	6,3	100,0
		Total	95	100,0	100,0	

After calculating the BAI, initial, 61 subjects (64.2%) were in the "healthy" category, 27 subjects (28.4%) were overweight, and 7 subjects (7.4%) were obese (Table 19). At the final evaluation, 67 subjects (70.5%) were in the "healthy" category, 22 subjects (23.2%) were overweight and 6 subjects (6.3%) were obese (Table 19). Neither the initial assessment nor the final assessment, according to the BAI were subject in the underweight category.

The correlations between age, weight, BMI, BAI, hip circumference, waist circumference, BF% and waist-hip ratio (WHR) at the initial and final test can be found in Tables no. 31 and 32. It can be seen, both at the initial and at the final test, that there is a high positive relationship between BF% and BMI, BAI, hip circumference and waist circumference, except for the WHR, in which the relationship is average (r = 445, p =, 000). This means that increased values of anthropometric parameters indicate high values of the body fat percentage.

Table 6. Correlations between age, weight, BMI, BAI, hip circumference, waist circumference, BF% and WHR at initial testing (N=95)

Correlations										
			Age	W (kg)	BMI	BAI	Hip	Waist	BF %	WHR
Spearman's rho	Age	Correl. Coef.	1,000	,373**	,450**	,384**	,381**	,471**	,349**	,402**
		Sig. (2-tailed)	.	,000	,000	,000	,000	,000	,001	,000
	Weight (kg) I	Correl. Coef.	,373**	1,000	,890**	,588**	,887**	,849**	,789**	,444**
		Sig. (2-tailed)	,000	.	,000	,000	,000	,000	,000	,000
	BMI I	Correl. Coef.	,450**	,890**	1,000	,815**	,819**	,854**	,824**	,530**
		Sig. (2-tailed)	,000	,000	.	,000	,000	,000	,000	,000
	BAI I	Correl. Coef.	,384**	,588**	,815**	1,000	,744**	,697**	,739**	,346**
		Sig. (2-tailed)	,000	,000	,000	.	,000	,000	,000	,001
	Hip (cm) I	Correl. Coef.	,381**	,887**	,819**	,744**	1,000	,821**	,810**	,282**
		Sig. (2-tailed)	,000	,000	,000	,000	.	,000	,000	,006
	Waist (cm) I	Correl. Coef.	,471**	,849**	,854**	,697**	,821**	1,000	,812**	,737**
		Sig. (2-tailed)	,000	,000	,000	,000	,000	.	,000	,000
	BF % I	Correl. Coef.	,349**	,789**	,824**	,739**	,810**	,812**	1,000	,445**
		Sig. (2-tailed)	,001	,000	,000	,000	,000	,000	.	,000
	WHR I	Correl. Coef.	,402**	,444**	,530**	,346**	,282**	,737**	,445**	1,000
		Sig. (2-tailed)	,000	,000	,000	,001	,006	,000	,000	.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7. Correlations between age, weight, BMI, BAI, hip circumference, waist circumference, BF% and WHR at final testing (N=95)

Correlations										
			Age	W (kg)	BMI	BAI	Hip	Waist	BF %	WHR
Spearman's rho	Age	Correl. Coef.	1,000	,355**	,412**	,312**	,311**	,413**	,240*	,387**
		Sig. (2-tailed)	.	,000	,000	,002	,002	,000	,019	,000
	Weight (kg) F	Correl. Coef.	,355**	1,000	,869**	,512**	,876**	,852**	,666**	,476**
		Sig. (2-tailed)	,000	.	,000	,000	,000	,000	,000	,000
	BMI F	Correl. Coef.	,412**	,869**	1,000	,778**	,795**	,843**	,750**	,539**
		Sig. (2-tailed)	,000	,000	.	,000	,000	,000	,000	,000
	BAI F	Correl. Coef.	,312**	,512**	,778**	1,000	,695**	,605**	,678**	,268**
		Sig. (2-tailed)	,002	,000	,000	.	,000	,000	,000	,009
	Hip (cm) F	Correl. Coef.	,311**	,876**	,795**	,695**	1,000	,788**	,700**	,275**
		Sig. (2-tailed)	,002	,000	,000	,000	.	,000	,000	,007
	Waist (cm) F	Correl. Coef.	,413**	,512**	,843**	,000	,788**	1,000	,737**	,766**
		Sig. (2-tailed)	,000	,000	,000	,605**	,000	.	,000	,000
	BF % F	Correl. Coef.	,240*	,666**	,750**	,678**	,700**	,737**	1,000	,484**
		Sig. (2-tailed)	,019	,000	,000	,000	,000	,000	.	,000
	WHR F	Correl. Coef.	,387**	,476**	,539**	,268**	,275**	,766**	,484**	1,000
		Sig. (2-tailed)	,000	,000	,000	,009	,007	,000	,000	.

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0,05 level (2-tailed).

6.6. Discussions

The mean weight of the group at baseline was 63.67 kg, and at follow-up, it was 62.39 kg, 1.28 kg less than the initial mean value. Although, according to the statistical analysis the loss is significant ($p = 0.000$), we consider that this weight loss after a 12-month activity

program is low. But we must keep in mind that the majority of subjects (68.4%) had a normal weight, they wanted to maintain weight and 6.3% of the subjects were underweight, they wanted weight gain, and the 20% overweight had lost on average 2.73 kg, and the 5.3% obese 3.25 kg.

The mean BMI, both initial (22.87) and final (22.40), was normal, but 25.3% of participants were overweight or obese at baseline.

The average value of the BAI, both initial (32.55) and final (31.79) was normal, but according to the adiposity index 35.8% of participants were overweight (28.4%) or obese (7.4%) at the initial evaluation, and 29.5% (23.2% overweight; 6.3% obese) at the final evaluation. In the group studied by us according to the BAI, no subject was in the underweight category, although according to the BMI, 6 subjects were classified in this category initially, and 7 subjects at the final evaluation. This indicates an overestimation of the BAI in those with low body fat percentage.

The correlations of BMI, BAI, waist circumference and waist-hip ratio with body fat percentage (BF%) were statistically significant, both at the initial and final evaluation, but the BF% correlations with BMI (initial *rho*=0.824, final *rho*=0.750) and with waist circumference (initially *rho*=0.812, final *rho*=0.737) were stronger than those with BAI (initial *rho*=0.739, final *rho*=0.688) and the waist-to-hip ratio (initial *rho*=0.445 final *rho*=0.484).

The initial mean BF% was 25.63% (± 6.53), which is normal, but 26 women had BF% above the threshold value, over 28%. Above this threshold it is considered an increased health risk (Jeukendrup & Gleeson, 2010). The mean final BF% was 22.97% (± 5.62), and the threshold of 28% exceeded only 18 subjects. The loss of 2.66% is statistically significant (p = 0.000).

Baseline mean of real body fat (BF kg) decreased with 2,16 kg from 16,95 (±7,61) kg to 14,79 (±6,26) kg, the loss is statistically significant (p = 0.000), and the age category at which the loss is the highest is 25-34 years: 2,89 kg.

The mean of fat-free mass increased from 46,71 (± 5,20) to 47,66 kg (± 5,51) kg.

6.7. Conclusions

The analysis of the relevance of anthropometric indicators of body fat led to the following conclusions:

- for the estimation of overweight and obesity, classifications based on BMI calculation are recommended;
- the waist-to-hip ratio showed weaker correlations with BF% than BAI, waist circumference and BMI;
- BAI overestimates body fat in individuals with lower BF%;
- the waist-hip ratio does not reflect the degree of overweight;

- waist circumference, as an index of abdominal fat, is recommended to be used to identify individuals who are at health risk for certain diseases.

Overweight and obesity occure in all age groups, but the highest percentage can be seen in the age category over 44 years (both initial 44.4% and final 44.4%); overweight and obesity increase with age.

The application of the combined physical activity program for 12 months demonstrated significant changes in body composition. It should be noted that the diet of the subjects did not change. The intervention program on body composition had a beneficial effect - by reducing the percentage of body fat by 2.68% and the real body fat by 2.16 kg, as well as increasing the lean mass by 0.95 kg. We would probably have had a greater impact on body composition, through the daily frequency of training, if we could have influenced and monitored the diet of the subjects. And in the applied program we did not have the possibility to differentiate the subjects by age groups. Another limitation of the study is the method used by us to determine the percentage of adipose tissue (based on skinfold thikness). We would have had more accurate results if we had the possibility and the necessary source for the bioelectrical impedance analysis or the DEXA analysis.

Chapter 7. Study II - Study on the effect of physical activities performed in gyms on the posture of adult women

Introduction

Posture is conditioned by hereditary predispositions, which include the constitutional character, the degree of muscle tonicity, gender; it also depends on other factors, such as age, body weight, health status, the nature of professional skills and the involvement of the individual to form and maintain a correct posture (Bratu, 1997).

According to Rosário (2014), the study of human posture is relatively new as compared to other areas of medical sciences. Posture can be altered by certain psychological conditions (James, Castaneda, Miller & Findley, 2009; Rosário, Nakashima, Rizopoulos, Kostopoulos & Marques, 2012). However, it is not an easy subject to study, mainly because postural assessments are still scientifically inaccurate (Rosário et al., 2012). Two methods are widely used for such assessments: the study of the projection of the center of gravity with the aid of a force platform; and photography of the standing posture, using both frontal and sagittal planes (Rosário et al., 2012). Some methods, such as MRI, are expensive, while others, such as X-ray, involve radiation problems (Suzuki et al., 2010; Berthonnaud et al., 2009; Steffen et al., 2010).

According to McEvoy and Grimmer (2005), the literature does not notice a standard approach to evaluate posture. The methodologies used in the study of postural alignments differ (Normand et al., 2007), and research usually evaluates only one segment, such as head and shoulder position (Aitken, 2008; Carneiro, Cardoso, Cunha & Teles, 2014; Raine & Twomey, 1997), curvature and length of thoracic kyphosis and lumbar lordosis (Dunleavy, Mariano, Wiater & Goldberg, 2010; Leroux et. al., 2000) or the alignment of the spine and pelvis in the lateral view (Roussouly, Gollogly, Berthonnaud & Dimnet, 2005), hampering any comparison of the results.

The main tool used to assess posture is visual analysis (Gangnet, Pomero, Dumas, Skalli & Vital, 2003), which can be aided by photographs.

Bogdani and Pano (2016), in a study analyzing the recent literature on the effects of physical activity on posture and postural regulation, concluded the following: in general, there are few studies that focus on the effects of physical activity on postural control and corrections. All studies enrolled a small number of subjects, leading to a need for further research with larger groups of subjects and different types of intervention programs to better identify which is most effective.

7.1. Purpose

The aim of our study was to detect visible physical deficiencies in women and to evaluate the effects of physical activities performed in gyms on the global and segmental body posture.

7.2. Hypothesis

In the present study we started from the following hypotheses:

1. The combined physical activity program (Pilates, step-aerobics and strength training) practiced in gyms, can have a beneficial effect on body posture (global and segmental), by improving or correcting it.
2. The effects of the intervention program on body posture (global and segmental) are different depending on the age range.

7.3. Objectives

We set the following objectives:

- assessment of the body posture (global and segmental) and the physical deficiencies of adult women, who attend gyms;
- detection of physical deficiencies;

- evaluating the effect of the intervention program on the body posture and on the physical deficiencies;
- evaluation of the strength and resistance of the muscles of the abdomino-lumbo-pelvic area (core muscles).

7.4. Materials and methods

7.4.1. Subjects

This study involved 95 adult women, who practiced physical activities in two gyms in Oradea, for 12 months, between February 2015 and June 2016. The research included only those women who showed interest, accepted the measurements and agreed that their data be used in research.

7.4.2. Methods

Global and segmental somatoscopic examination was performe in the anterior frontal plane, posterior frontal plane and sagittal plane.

For the storage, objectification, confirmation and subsequent analysis of the data of the global and segmental somatoscopic examination, there were performed photo images also at the anthropometric frame, under the same conditions. The photos were processed on a computer using the Kinovea program, version 8.15 (Figure no.41).

The data obtained were statistically analyzed with the IBM SPSS program, version 23 (descriptive analysis, frequency).

The physical activity program consisted in combined training of Pilates, Step - aerobics and strength training in the gym, 3 times a week for 60-90 minutes, for 12 months, presented in more detail in the previous study.

Figure no.41. Somatoscopic evaluation; example no.3 of photo processing

7.5. Results

95 adult women were evaluated, of which at the initial global somatoscopic evaluation 46 (48.4%) had scoliotic body attitude, 18 (18.9%), lordotic attitude, 13 (13.7%), normal body attitude, 6 (6.3%) kypho-lordotic, 5 subjects each (5.2%), kyphotic and lordo-scoliotic and 1 subject each (1.1%), flat back and kypho-lordo-scoliotic attitude (Table no.41 and Figure no.42).

At the final global somatoscopic evaluation, 38 (40%) had scoliotic body attitude, 17 (17.9%), lordotic, 32 (33.7%), a normal body attitude, 2 (2%), kypho-lordotic, 2 subjects (2.1%), kyphotic, 3 (3.2%), lordo-scoliotic and 1 person (1.1%), kypho-lordo-scoliotic (Table no.41 and figure no.42).

Table 8. Prevalence of global postural attitudes at initial and final assessment (N=95)

Global postural attitudes	**INITIAL**		**FINAL**	
	No. of subjects	**Percentage**	**No. of subjects**	**Percentage**
Normal	13	13,7%	32	33,7%
Lordotic	18	18,9%	17	17,9%
Kyphotic	5	5,2%	2	2%
Scoliotic	46	48,4%	38	40%
Kypho-lordotic	6	6,3%	2	2,1%
Lordo-scoliotic	5	5,3%	3	3,2%
Kypho -lordo-scoliotic	1	1,1%	1	1,1%
Flat back	1	1,1%	-	-
TOTAL	**95**	**100%**	**95**	**100%**

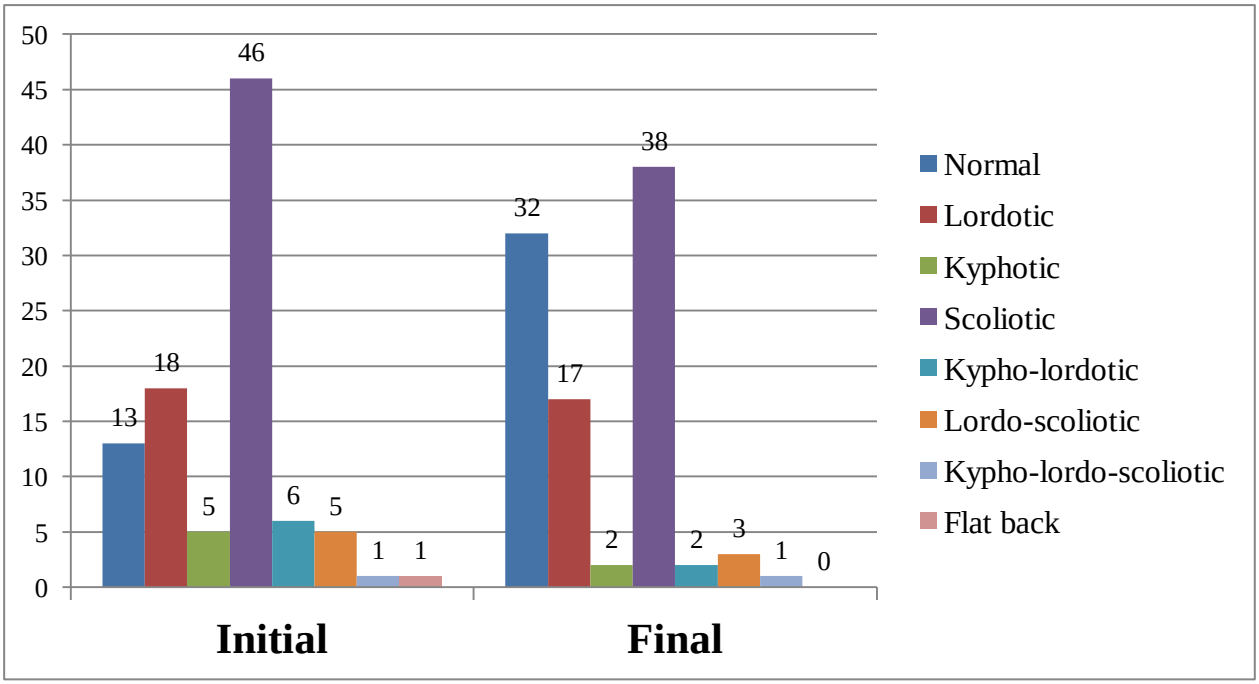


Figure no. 1. Numerical prevalence of global postural attitudes at initial and final testing

In the whole group, following the segmental somatoscopic evaluation of the spine, we found the following: initially 7 subjects (7.4%) did not show any deviation or showed minor deviation of the spine, 41 (43.1%) had a form of scoliosis (in C, in S, lumbar, thoracic, dorso-lumbar), 21 (22.1%) presented lordo-scoliosis, 14 (14.7%), lumbar hyperlordosis, 6 (6.3%), kypho-lordo-scoliosis, 2 subjects each (2.1%), kyphosis, respectively thoracic flat back with scoliosis and 1 subject each (1.1%) had kypho-lordosis, respectively kypho-scoliosis (Table no. 56 and Figure no.45).

Table 9. Initial and final segmental somatoscopic evaluation of the spine (N=95)

Vertebral column	**INITIAL**		**FINAL**	
	No. of subjects	**Percentage**	**Nr. of subjects**	**Percentage**
Without/minor deviation	7	7,4%	23	24,2%
Scoliosis	41	43,1%	39	41%
Lordo-scoliosis	21	22,1%	11	11,6%
Lumbar hyperlordosis	14	14,7%	16	16,8%
Kypho-lordo-scoliosis	6	6,3%	4	4,2%
Kyphosis	2	2,1%	-	-
Flat back + scoliosis	2	2,1%	-	-
Kypho-lordosis	1	1,1%	1	1,1%
Kypho-scoliosis	1	1,1%	1	1,1%
TOTAL	**95**	**100%**	**95**	**100%**

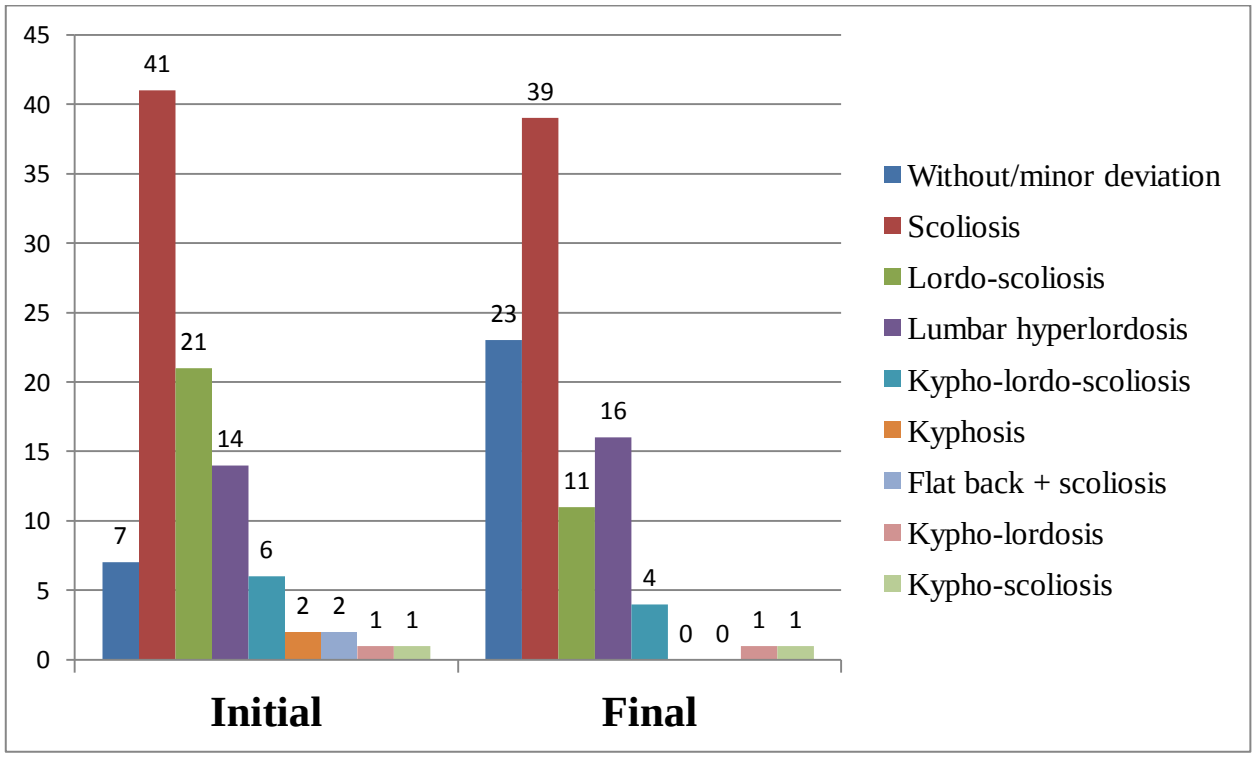


Figure no. 2. Numerical prevalence of spinal deviations at initial and final segmental somatoscopic evaluation

At the final evaluation, 23 subjects (24.2%) showed no deviation or showed minor deviation of the spine, 39 (41%) had scoliosis, 11 subjects (11.6%) lordo-scoliosis, 16 (16 , 8%) lumbar hyperlordosis, 4 (4.2%), kypho-lordo-scoliosis and 1 subject each (1.1%) had kypho-lordosis, respectively kypho-scoliosis. There were no subjects with kyphosis and thoracic flat back (Table no. 56).

7.7. Conclusions

The research we conducted highlighted that the most common deficient global postural attitude was scoliotic: 46 subjects (48.4%) presenting it at the initial evaluation, respectively 38 subjects (40%), at the final evaluation.

The frequency of deficient global postural attitudes was highest at the age range 25-34 years, namely 30 (96.7%).

Regarding the most common postural misalignments, we observe that:

- forward head posture was common in each age group, but it was most common in the age group under 25 years (21 subjects, 51.2%);
- one shoulder higher or lower than the other was most often encountered at the age range over 44 years (8 subjects, 88.9%);
- scoliosis of the spine was the most common at the age range over 44 years (6 subjects, 66.7%);
- pelvic anteversion was most common at the age range 25-34 years (13 subjects, 41.9%);
- genus valgum in the lower limbs was most common in the age range 25-34 years (8 subjects, 25.9%).

The application of the combined physical activity program for 12 months contributed to improvements in global body attitude and body posture, the number of people with a normal global postural attitude increasing from 13 people (13.7%) to 32 (33.7%).

Also, at the segmental somatoscopic evaluation, improvements can be observed in all body segments:

- the number of subjects with normal head and neck position increased from 36 (37.9%) to 62 (65.2%);
- the number of subjects with normal shoulder position increased from 22 (23.1%) to 49 (51.5%);
- the number of subjects without deviation or with minor deviation of the spine increased from 7 (7.4%) to 23 (24.2%);
- the number of subjects with normal pelvic position increased from 31 (32.6%) to 46 (48.4%);

- the number of subjects with the normal position of the lower limbs increased from 59 (62.1%) to 75 (78.9%).

At the core muscle strength and stability test, almost all subjects improved their results: the number of subjects who received the excellent grade increased from 5 (5.3%) at the initial evaluation, to 31 (32.5%) at the final evaluation. So we can conclude that our hypothesis has been confirmed, the combined physical activity program (Pilates, step-aerobics and strength training) having a beneficial effect on the global postural attitude, by improving or correcting it.

As a result of the initial evaluation in our study, cases of major physical deficiencies were detected, some people were not aware of the severity of the deficiencies. They were referred to a specialist and to physiotherapy.

Chapter 8. Study III - Study on the effect of physical activities on the quality of life in adult women

Introduction

The interest shown in the medical world for the patient's quality of life issues is demonstrated by the number of articles on the quality of life published in prestigious journals and presented in the PUBMED database of the National Library of Medicine, USA (Lupu, 2006). We find a constant and spectacular increase of the articles dedicated to the study of different aspects of the quality of life, from 1 article, in the period 1950–1960 to 30841 articles, in the interval 1991–2000, and in 2019 to 35582 articles.

The 2016 European Quality of Life Survey highlights that participation in sport or exercises increases life satisfaction and that regular exercise has been shown to be associated with greater subjective well-being (Eurofound, 2017). Women, as a rule, are less active than men (Sport England, 2015, 2016). In relation to health, the quality of life is a particularly important concern among women. They constantly complain of worse health than men (Marks, 2003).

8.1. Purpose

The aim of our study was to analyze the effect of a combined physical activity program (Pilates, step-aerobics and strength training) on the quality of life of adult women. At the same time, we wanted to see how weight loss influences the quality of life of the subjects participating in the study.

8.2. Hypothesis

In this study we started from the following hypotheses:

1. The combined physical activity program (Pilates, step-aerobics and strength training), practiced in gyms increases the quality of life.
2. Weight loss and a decrease in body mass index increase the quality of life.

8.3. Objectives

We set the following objectives:

- application of the intervention program;
- evaluating the quality of life of adult women included in the research;
- analysis of the effect of the intervention program on the quality of life;
- analysis of the link between obesity, overweight and the quality of life.

8.4. Materials and methods

8.4.1. Subjects

This study included the persons included for the other two studies, 95 adult women, who practiced physical activities in two gyms in Oradea, for 12 months, between February 2015 and June 2016. Only those women who showed interest, accepted the measurements and agreed to use the data in the research were included in the research.

8.4.2. Methods

Anthropometric measurements were performed according to the standards described by ISAK - International Society for the Advancement of Kinanthropometry - height (in cm), weight (in kg) - and body mass index (BMI) was calculated.

For the evaluation of the quality of life we used the SF-36 questionnaire (annex no.3). Also known as MOS-SF-36 - Medical Outcome Study-Short Form 36, this is a validated questionnaire, an abridged form, consisting of 36 questions; it can be applied in studies performed on a specific or general population. It includes 8 stages of functional health, a summary of the basic values of physical and mental health and a health index. The 8 aspects of health were selected from the 40 originally included in the Medical Outcome Study. The detailed description of the test, respectively the scoring can be found in chapter 5, subchapter "5.3.5. Evaluation of the quality of life".

Data from measurements and application of the quality of life questionnaire were statistically analyzed using IBM SPSS, version 23.

The physical activity program was identical to that used for the other two studies.

8.5. Results

The results following the application of the questionnaire, at initial and final assessment, can be followed in Table no. 77, separately on the 2 major components of quality of life, physical health and mental health, and in figure no. 48.

The analysis of the answers to the questionnaire revealed the following: the initial average score of quality of life was 85.01, and the final one was 89.40; the initial average score of the physical health component was 87.54, and the final one 92.10; the initial average score of the mental health component was 82.48, and the final one was 86.69 (Table no. 77).

Table 10. Descriptive analysis of quality of life scores recorded by study participants (N=95)

		Media (AS)	Min	Max	Diferența I - F
Quality of life	**Initial**	85,01 (8,77)	49,73	98,25	- 4,39
	Final	89,40 (6,13)	69,29	100	
Physical Health Component	**Initial**	87,54 (9,83)	50	100	- 4,57
	Final	92,11 (6,33)	71,25	100	
Mental Health Component	**Initial**	82,48 (10,44)	36,75	99	- 4,21
	Final	86,69 (8,29)	50,45	100	

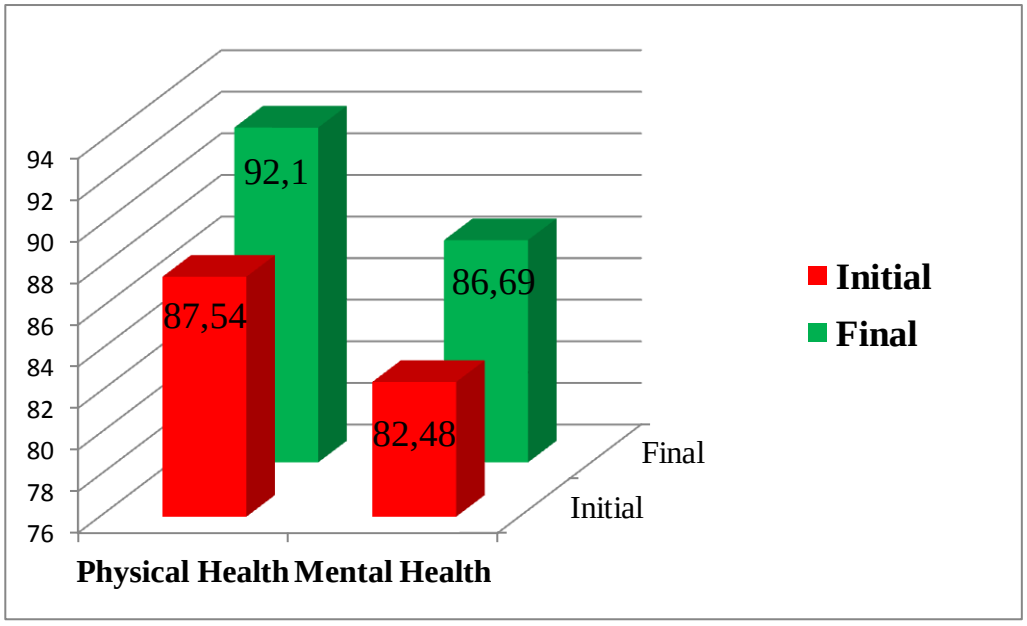


Figure no. 3. The initial and final average values of the two components of quality of life

To determine the relationships between weight, BMI, quality of life, physical and mental health component of quality of life we used the correlation coefficient. As the data were not normally distributed, the Spearman test was used (Tables no. 89 and 90).

Table 11. Correlations between weight, BMI, quality of life, physical health component of quality of life and mental health component of quality of life at initial testing (N=95)

Correlations

			W (kg) I	BMI I	Quality of life Initial	Physical Health Initial	Mental Health Initial
Spearman's rho	W (kg) I	Correlation Coefficient	1,000		-,173	-,174	-,182
		Sig. (2-tailed)	.		,094	,093	,077
		N	95		95	95	95
Spearman's rho	BMI I	Correlation Coefficient		1,000	-,114	-,126	-,115
		Sig. (2-tailed)		.	,269	,225	,268
		N		95	95	95	95

Tabel 12. Correlations between weight, BMI, quality of life, physical health component of quality of life and mental health component of quality of life at final testing (N=95)

Correlations

			W (kg) F	IMC F	Quality of life Final	Physical Healht Final	Mental Health Final
Spearman's rho	W (kg) F	Correlation Coefficient	1,000		-,143	-,143	-,148
		Sig. (2-tailed)	.		,167	,166	,152
		N	95		95	95	95
Spearman's rho	BMI F	Correlation Coefficient		1,000	-,114	-,094	-,127
		Sig. (2-tailed)		.	,273	,364	,219
		N		95	95	95	95

8.7. Conclusions

Following the intervention program, the quality of life of the subjects improved: it increased from the score of 85.01 to 89.40. In the age category 35-44, the quality of life improved the most (the score increased from 83.35 to 90.25), both in the physical health component (by 7.59) and in the mental health component (with 6.22).

The overweight and obese subjects have lost more weight and the quality of life scores has improved more than at the whole group, which indicates a fact about the quality of life, namely that it is inversely proportional to weight loss: if weight decreases, the quality of life increases. Weight loss is associated with increased quality of life, but in the present research we did not find a statistically significant link.

The highest score of the physical health component can be observed at the age range <25 years, both initial (89.48) and final (93.42). The highest score of the mental health component of the quality of life initially can be observed at the age range >44 years (86.69), and at follow-up, at the age range 35-44 years (88.41). Our findings show similar trends to the results of similar research, namely: the physical health score is highest in young people and decreases with age,

but the mental health score is exactly the opposite, it is higher in the elderly and lower in the young .

Our study concluded that the application of a physical activity program for 12 months leads to an improvement in the quality of life of the people participating in the research, so we can say that the hypothesis has been confirmed.

General conclusions and recommendations

The application of the combined physical activity program (Pilates, step-aerobics and strength training) for 12 months demonstrated significant changes in body composition. The intervention program on body composition had a beneficial effect – by reducing the body fat percentage by 2.68% and the real body fat by 2.16 kg, increasing the lean mass by 0.95 kg. At the same time, the training program had a beneficial effect on the global body attitude and on the physical deficiencies, by improving or correcting them, the number of people with a normal global postural attitude increasing from 13 people (13.7%) to 32 (33.7%).

The average value of the quality of life of the sample, after the physical activity program for 12 months, shows an improvement, increased from 85.01 to 89.40, by 4.39. The score of the physical health component increased more slightly (by 4.57) than the score of the mental health component (by 4.21). It can be seen that in the overweight and obese, the increase in the quality of life score was higher than in the whole group (as was also higher their weight loss). In the age category 35-44 years, the quality of life improved the most, both the physical (by 7.59) and mental health (by 6.22) components.

So we can conclude that the research hypotheses have been confirmed: regular exercise has the effect of increasing the quality of life and training programs have a beneficial effect on body posture, physical deficiencies - by improving or correcting them - and body composition - by reducing body fat.

Other research findings:

- for the estimation of overweight and obesity, classifications based on BMI calculation are recommended;
- the waist-hip ratio showed weaker correlations with the body fat percentage than the body adiposity index, waist circumference and BMI;
- the body adiposity index overestimates body fat in individuals with a low BF%;
- the waist-hip ratio does not reflect the degree of overweight;
- waist circumference, as an index of abdominal fat, is recommended to be used to identify individuals who are at risk of health from certain diseases;

- overweight and obesity occur in all age groups, but the highest percentage can be seen in the age group over 44 years. Overweight and obesity increase with age;
- in our study, the most frequent deficient postural attitude was the scoliotic one (46 subjects, 48.4% at the initial evaluation, respectively 38 subjects, 40% at the final evaluation), and the most frequent segmental postural misalignments were: forward head posture (48.4%), one shoulder higher or lower than the other (73.7%), scoliosis (43.2%), pelvic anteversion (33.7%), valgus knee (23.2%);
- following the study, cases of major physical deficiencies were detected (34 subjects, 36.9%), some people were not aware of the severity of the deficiencies. They were referred for examination to a specialist;
- in the group studied by us, at the age range 25-34 years we detected the most deficient global postural attitudes, namely 30 (96.7%).
- the score of the physical health component of the quality of life is the highest in the young and decreases with increasing age, but the mental health score is exactly the opposite, it is higher in the elderly and lower in the young.

In conclusion, we consider that the research carried out in this doctoral thesis has achieved its main purpose and objectives: optimizing the improvement of health, the correct body posture of women and improving the quality of life.

The partial results published in the journals sounded the alarm to the management of the gym where the research took place. Based on the findings of the research following the segmental somatoscopic evaluation of the spine, namely that only 7 subjects (7.3%) showed no deviation or showed a minor deviation of the spine, the owner of the fitness center understood the need for evaluation and monitoring of the clients. After presenting the results, the evaluation protocol and our proposal to change the approach of clients in the gym, he decided to invest in postural analysis and detection of physical deficiencies. He bought a POSTUROTEST postural analysis device and intends to open a physiotherapy part in the gym. Future research should be performed on a larger number of subjects and with the help of the posturotest.

We come up with a recommendation for all fitness centers in the country: the introduction of an evaluation protocol for each client, who attends the gym, which includes anthropometric measurements, somatoscopic evaluation and quality of life evaluation. To have a database with each client, and the assessments to be conducted regularly, every 3 months.

Elements of originality:

- a complex approach of the subjects: evaluation of the body composition, posture and the quality of life and optimization of the means used in gyms for their improvement;

- the use of a combined training program, based on the new recommendations of the American Association of Sports Medicine (2018) on physical activity in adults aged 18-64 (which includes both moderate/vigorous aerobic physical activity, muscle strengthening, endurance exercises, as well as exercises to improve balance, coordination and flexibility);
- elaboration of a protocol for evaluating the clients who attend fitness gyms: anthropometric measurements, somatoscopic evaluation and application of the quality of life questionnaire;
- the proposal to introduce in the gyms the obligatory evaluation of all clients, regarding the posture, the body composition and the quality of life.

Limits of the research

There are two major limitations in this research that could be addressed in future research. The first is related to the size of the sample included in the research: the number of subjects was not large enough to be considered representative. The second limit consists in the methods used by us for the determination of the body fat percentage (based on anthropometric measurements) and for the postural analysis (somatoscopic and by the analysis of photographs). We would have had more accurate results if we had the possibility of bioelectrical impedance analysis or DEXA analysis for body composition and posturotest software for postural analysis.

It should be noted that the diet of the subjects has not changed. We would probably have had a greater impact on body composition, through the daily frequency of training, if we could have influenced and monitored their diet. And in the applied program we did not have the possibility to differentiate the trainings of the subjects according to the age groups.

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