

# Quality of Life: Effects of Physical Activity in an Anthropometric, Cognitive and Psychosocial Background, and Variation of Odontoiatric Parameters

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<sup>3</sup>doi:10.23756/sp.v5i2.371



## Abstract

The "Quality of Life" project arises from the need to observe and define the existing interconnection between a "healthy" lifestyle and the quality of life perceived by people. Starting from the W.H.O. (World Health Organization) definitions of quality of life and health, and analysing the studies that describe the benefits of both movement physical and mental, a three months protocol has been set for the pursuit of a diet and personalized training. For this purpose, 20 healthy subjects from the 1st year of the Physiotherapy degree, who had never practiced sports at an agonistic level, have been recruited. All individuals were subject to initial evaluations to define psycho-physical wellbeing, then they have been divided into two groups: the first group, defined as experimental, followed the protocol for the duration of the study, while the second, was only subject to evaluation. At the end of the three months period, the subjects of both groups were evaluated twice, the first immediately after the last training session, the second was evaluated one month from the latter. The final evaluation aimed at verifying a possible conservative effect on modification of experimental group parameters, even when physical activity and nutrition were not supervised by us. The goal of the project was to specifically analyse, after three months, the changes in cognitive memory capacity and concentration, the stress experienced in work or

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<sup>3</sup> ©Rosa Grazia Bellomo et al. Received: 25-11-2017. Accepted: 27-12-2017. Published: 31-12-2017.

study, and psycho-physical wellbeing perceived by the concerned subjects. Data collected during the three evaluations showed that in the experimental group, as our scientific protocol has altered all these parameters in terms of quality of life in positive terms, modifications are susceptible to changes in the event that physical activity and 'proper nutrition are not followed.

**Keywords:** quality of life; well-being; health; sport.

## 1 Introduction

W.H.O. defines health as "*a state of complete physical, social and mental wellbeing, not just absence of illness,*" while describing quality of life as "*a very broad concept that encompasses complex, physical and psychological health of every single individual, the level of independence, social relationships, personal beliefs and the relationship with the salient features of the environment.*" W.H.O. has identified six major areas to describe at an intercultural level the key aspects of quality of life: physical (e.g. energy, fatigue, tiredness) and psychological (e.g., positive feelings), independence, social relations, the environment and personal beliefs/spirituality. These "ambitions are complementary and superimposed." [1] It has been shown that there is a strong association between the pursuit of a healthy lifestyle and the perceived quality of life [2] [3]. W.H.O. identifies in the physical inactivity possible reasons of pathologies that cause about 2 million in deaths every year in the world; on the contrary, any increase in physical activity translates into a health benefit [4]. Because of this reason, physical activity can be an ideal tool for promoting quality of life and to build a fundamental therapeutic role in viewing health as the setup of well-being rather than its restraint. [5] It is well known that regular physical activity is a key prevention strategy for cardiovascular disease, obesity, diabetes mellitus, depression, cancer, also in association with interventions reducing other risk factors, such as smoking, stress, overweight [2, 6, 7]. Scientific literature shows how physical exercise can be a true therapeutic method [8] [9], demonstrating its effectiveness in association with conventional drug treatment [10] [11]; This is most evident for pathological conditions such as: metabolic syndrome [12], diabetes mellitus [13] [14, 15], arterial hypertension [16, 17], obesity [18, 19], COPD [20, 21], cardiovascular disease [22, 23] and heart failure [24] [25], [26], [27]. Physical exercise, by strengthening and increasing muscular resilience, is also the main method for restoring proper bodily alignment [28], which is implemented through feed-back and feed-forward skeleton circuits, both direct and inverse, that tend to ergonomically lower energy consumption yielding greater comfort [29] [30]. Posture, understood as the evolutionary and adaptive alignment between the skull and the bodily segments by spatial relationship in

response to the surrounding environment, affects the psycho-physical wellbeing. Therefore, the persistence of a postural dysfunction, as the condition in which subsystems are involved by vicious spatial alterations, causing alterations both in static and dynamic equilibrium; can cause the onset of discomfort, pain and disability, in relation to its duration or severity [31] [32] [33] [34] [35]. Several studies have demonstrated the positive effects of regular physical and/or sports activity on mood [36-38], concentration and cognitive processes [39] [40]. Young athletes, for example, have higher school grades than average, they graduate on time and have fewer dropout rates. In addition, it has been shown that the sense of self-discipline acquired in sports is also reflected in classroom attendance, concentration and carrying out homework [41]. For this reason, O'Donnell et al. emphasize how promoting health and psycho-physical wellbeing, in the context of Universities and schools, is to efficiently promote more effective learning [42]. Several mechanisms have been hypothesized, through which exercise exerts a positive influence on the cognitive process: an increase in blood and brain oxygen flow [43]; increased levels of noradrenaline and endorphins [44], resulting in reduced stress and mood improvement [45] [46]; increase in brain growth factors and support for synaptic plasticity [47] [48]. It has already been shown that the health of the oral cavity affects the quality of life, self-esteem, ability to feed, and general health, while its illness causes pain, anxiety and altering social functions [49-53]. The connection between physical activity and oral health is known [54]. Needleman and Coll. have largely shown that oral health is a key element of overall health, the state of wellbeing and the quality of life of athletes [55]. Several studies have shown that agonist sportsmen lowered their amounts of carogenic microorganisms and high levels of protective bacteria associated with a low incidence of active caries [56]. Additionally, athletes present clinical indicators (DMFT, Plaque Index, Gingival Index) better than those who do not practice sports [57]. Saliva is an oral fluid, involved in many functions of oral health and homeostasis, and plays an active role in maintaining the oral health itself. Interest in it as a diagnostic material has grown exponentially over the past 10 years. Healthy adults produce 500-1500 mL of saliva per day, at a rate of about 0.5 mL / min, but different physiological and pathological conditions can modify saliva production both quantitatively and qualitatively. Smell and taste stimulate saliva production and secretion as well as chewing, hormonal and psychological state, certain drugs, age, hereditary influences, oral hygiene and exercise. Particularly, the performance of sports activities influences the main characteristics of saliva, such as consistency, flow, pH, and buffer capacity. As widely demonstrated, determining these characteristics by associating it with the monitoring of bacterial count, oral immunological status, oral clinical indexes, eating habits, sporting characteristics (intensity, duration and frequency of exercise) allows

to obtain excellent oral health control [57]. The "Quality of Life" project has the goal of verifying and quantifying how a healthy lifestyle characterized by a good level of physical activity, proper nutrition and good oral hygiene, coupled with a stimulating and engaging environment such as University, is able to influence the quality of life perceived by the individual, the psychosomatic component, cognitive, studies performance, and oral health. In particular, the fields of investigation are mainly: postural attitude, anthropometric parameters, body composition, dental parameters, the cognitive and psycho-social sphere.

## **2 Materials and Methods**

In the framework of the chair of physical and rehabilitation medicine at the University "G. d'Annunzio" of Chieti-Pescara and in collaboration with the Department of Oral, Medical and Biotechnology at the same University; 60 subjects, enrolled in the degree course in Physiotherapy have been selected for this study. The sample was randomized into two groups each composed of 30 subjects: experimental group (A) and control group (B).

### ***Group A***

Individuals of this group have been subject to:

- Workout, 3 times a week for 12 weeks at the G. D'Annunzio University - Chieti gym;
- Correction of dietary habits through nutrition counseling, and compilation of a 3-day dietary journal, consisting of 2 weekdays and one day on weekends;
- Instructions for proper oral hygiene.

### ***Group B***

Subjects in this group received instructions on how to take care of their oral hygiene, but did not change their lifestyle.

### **Inclusion criteria for both groups**

- Healthy subjects aged between 19 and 21 years;
- subjects who have never practiced sports at a competitive level
- no osteoarticular trauma in the previous 12 months
- subjects deemed fit for physical activity

### **Exclusion criteria for both groups**

- Pharmacological therapy in place;
- chronic or acute pathologies;
- subjects recently undergoing surgery (at least 12 months).

## **EVALUATION OF PATIENTS**

Group A was evaluated prior of treatment at time 0 (T0), at the end of quarterly training at time 1 (T1) and also 30 days after the last training session for follow-up (T2). Group B was evaluated at T0, after 3 months at T1 and 30 days after the last at T2. Both groups were evaluated with:

- 1 RAROG system;
- 2 Bioelectrical Impedance Analysis (BIA);
- 3 Dental parameters;
- 4 Anthropometric parameters;
- 5 Digit Span Test;
- 6 Quality of Life Enjoyment and Satisfaction Questionnaire-short form.

### **RAROG system**

The RAROG system allows a postural evaluation without marking, with no influence from the operator. The acquisition of the image takes place at a frequency of 30 frames per second and each analysis has a duration of 5 seconds; the average image, therefore, is the resulting 150 frames. The RAROG software is able to rebuild a 3D avatar called Skeletal View. The Skeletal View consists of 20 anatomical points. The resulting avatar from this media is split into two projections, front and sagittal, in which it is possible to analyse various parameters. For this study, the following parameters were used: horizontal frontal vision of shoulders; posterior vision of shoulders; horizontal frontal vision of pelvis and the front-position vision of basin.

### **Bio-impedance**

Performed with "AKERN BIA 101 ANNIVERSARY", a non-invasive, quick, painless, reliable and repeatable measuring instrument that delivers quantitative and qualitative data on body composition, hydration and nutritional status. The parameters analysed are: T.B.W. (Total Body Water), B.C.M. (Body Cell Mass or Cell Mass), B.C.M.I. (Body Cell Mass Index), Phase Angle (Ratio between Resistance and Reactance).

### **Dental parameters**

The evaluations were made at the beginning of the training period (T0), at the end of the three training months (T1), and one month after the end of the working period (T2). For the evaluation of oral hygiene, a dental examination was carried out in which an intraoral mucous and hard tissue examination was performed, oral hygiene was evaluated, in lieu of whether or not there were spoiled habits, parafunctions and the presence of malocclusions. For each subject, the number of chest (D) teeth, missing teeth (M), and filled (F) teeth were recorded to assess the prevalence of caries according to WHO criteria. To

evaluate oral hygiene and periodontal status, a Plaque Index (PII) was used respectively according to Silness & Løe and Løe & Silness Gingival Index (GI). In addition, oral hygiene practices (toothbrush frequency and dental floss use) were monitored. At each observation time, salivary sampling was performed on each subject for the determination of the following parameters:

- Basal pH
- pH of stimulated saliva
- stimulated saliva quantity (ml/5 min)
- Saliva swab capacity
- Streptococcus mutans
- Lactobacillus spp

For non-stimulated saliva, subjects were asked to keep saliva in the mouth for 30 seconds. For stimulated saliva collection, the patient was asked to chew a piece of paraffin gum for 5 minutes, collecting at regular intervals all the saliva produced in a specially sized container. Basal saliva collected at T0, T1, T2 was subjected to pH determination using pH meter (Elettrofor XS instruments, Borsea, Italy). The stimulated saliva was used to determine its amount and buffer capacity, with the help of the GC Saliva Check Kit (GC Corp., Belgium). The stimulated saliva was used to estimate the number of Streptococcus mutans (SM) and Lactobacillus counts per milliliter of saliva (CFU/mL) counting units using CRT presumptive bacteria (Ivoclar-Vivadent, Schaan, Liechtenstein). At all stages, patients avoided eating or drinking and did not brush teeth at least 2 hours before performing evaluations.

### **Anthropometric parameters**

The parameters analyzed for the anthropometric study are: weight, BMI, waist circumference and hips, lower limb circumference, taken in 4 points, both right and left, with point 0 on the crown, +10 and +15 cm proximally on the thigh, -10 cm distally on the leg.

### **Digit Span Test**

Digit Span Test is a subtest of Wechsler's Adult Intelligence Scale and Wechsler Memory Scale. With the help of the "Attention and Memory-Erikson" software, this evaluates the ability of the subject to store sequence numbers ranging from 0 to 9 with two different modes: In Digits Forward (A), the sequence must be repeated in chronological order at the appearance of figures; in the Digits Backward (B), the sequence must be repeated from the last digit on the screen. The score given derives from the sum of mode (A) and mode (B), higher scores are positivity index. 89% of normal subjects has a Forward Span between 5 and 8 (Kaplan, Fein, et al., 1991).

### **Quality of Life Enjoyment and Satisfaction Questionnaire-short form**

This questionnaire is intended to assess the degree of pleasure and satisfaction experienced during the previous week, through 16 items.

### **Treatment Mode**

As far as nutrition is concerned, subjects in the experimental group have undergone nutritional counseling where they have been informed on the benefits of proper nutrition and the pathologies resulting from wrong food education. Subsequently, they compiled a 3 days journal, consisting of 2 weekdays and one day on the weekend. As far as physical activity is concerned, Group A has undergone functional training to develop the main motor skills, such as conditional capacity (strength, endurance, power); Coordination capacities (balance, motor and postural control, agility, motor adaptation); articular mobility. Each training session, held at the G. D'Annunzio - Chieti University. At the Heating phase stage, the subject performs a 10 minutes low muscular activity with the aid of bicycles, treadmills or elliptical exercises. Before starting the training phase, the subject performs a static stretching that involves a slow and complete stretching of the muscle, maintaining the position for a period of time ranging from 15 to 30 seconds and repeating the exercise for 3-4 times. At the Coach Phase stage, the subject must play 4 circuits, each consisting of free-body exercises, each circuit contains a variable number based on the job required for the subject. The quarterly exercise activity in the gym was divided into four phases, which resulted in recovery times ranging between individual exercises and circuits so as to have progressive activity within three months. In the first phase, each exercise takes place for 20 seconds, the subject pauses for 10 seconds before starting the next exercise. As for circuits, the subject has 1 minute of pause after running the second circuit or half of the functional activity. In the second phase, each exercise takes place for 30 seconds, the subject pauses for 10 seconds before starting the next exercise. As for circuits, the subject has 1 minute of pause after running the second circuit or half of the functional activity. In the third phase, each exercise takes place for 30 seconds without interruption between exercises. As for circuits, the subject has 1 minute of pause after running the second circuit or half of the functional activity. In the third phase, each exercise takes place for 30 seconds without interruption between exercises. As far as circuitry is concerned, the subject does not pause in the middle of the functional activity. At the Cool down phase stage, the subject performs a low-intensity muscle activity of 10 minutes with the aid of cycling, treadmills or elliptical exercises, adding a static stretching that provides a slow and complete stretching of the muscle, maintaining the position for a variable period of 15 to 30 seconds and repeating the exercise for 3-4 times.

### **Dental evaluation**

Both groups were subject to professional oral hygiene and both were motivated to home oral hygiene. Those who practice sports activities improve home hygiene, keeping it steady. With regard to dental floss use, after an initial interest, the frequency decreases. As far as clinical evaluation is concerned, subjects have a total DMFT (decayed missing filled teeth index) of 4.65. The plaque index (PII) is positive in 80% of the examined subjects. In group A, it was 60% positive for both T1 and T2. In group B, after an improvement in T1 (60%), they returned to base conditions. Bleeding index (GI) does not undergo significant variations between T0 and T1, and only in T2 of group A there is a small decrease (60% at T0 vs 40% at T2). The basal pH of the collected saliva highlights that in the subjects of group A the values do not undergo significant changes in the three observation times. In group B, on the other hand, there is a decrease at T1 and an increase at T2. The amount of stimulated saliva (ml/5min) increases in group A, at time T1 and T2 with respect to T0. In group B, there is a decrease between T0 and T2. At T1 the group A shows a marked increase in buffer capacity, which is high in 80% of the tested against 50% calculated at T0; while at T2, the values reset to the initial values. In Group A, there is a decrease in *S. mutans* and *Lactobacillus* spp. In group B, no variation is observed for *S. mutans* and small variations for *Lactobacillus* spp.

### **Anthropometric parameters**

In Group A, with regard to weight data and the evaluations of B.M.I., we observe an improvement of these two values at T1 respect to T0. The average weight value ranges from 63.3 kg to 61.8 kg. The average BMI value between T0 and T1 decreases, from 21.61 to 21.27. At T2 the average value remains practically unchanged. However, these data are simple indications and do not give the actual measure of how much the lean and fat mass increased or decreased. As to the waist of circumference, there is a decrease in the mean value between T0 and T1, with a value that decreases by 3 cm on average. Between T1 and T2 there is an increase in the average circumference ranging from 71.7 cm to 72.7. The waist circumference is a parameter that undergoes a decrease between T0 and T1: the average value is 99.2 cm and it reaches 95.8 cm. At T2, this value has an increment, of 1 cm. As to the measurement of the circumference of the lower limbs, we found a slight increase of the circumference at T1s respect to T0. However, this change is temporary, in fact at T2 the values tend to return to the situation found in the initial evaluation (T0). The weight of patients, between T1 and T2, changes from 68.68 kg to 68.17 kg on average. For the B.M.I. we have minimal modifications, for all 3 evaluation moments. As regards the circumference of waist and hips, these remain identical during the three evaluations. As for the circumference



measurement of the lower limbs, both on the right and left, there is an increase in the average progressive value from T0 to T2. At a point at 10 cm from the patella, in the cranial direction, we have a similar trend of values, as they increase between T0 and T1 of 0.8 cm, both left and right and between T1 and T2, there is a decrease of 0.2 cm. At a point at 15 cm from the patella in the cranial direction, between T0 and T1, we can observe an increase of 0.6 cm on the left and 0.5 cm on the right. The circumference at 10 cm from the caudal patella undergoes an increase between T0 and T1 and to the left (0.6 cm) and to the right (0.7 cm) of the average value.

### **Digit Span Test**

To evaluate the effects of exercise on cognitive functions, the Digit Span Test in the Forward and Backward versions was submitted to both groups. In group A, we note an increase in the mean value of response at T0 respect to T1, a value that also undergoes a small increase in T2 follow-up. In group B, we notice a substantial stability of the mean values at the 3 evaluations time.

### ***Q-LES-Q-SF - Quality of Life Enjoyment and Satisfaction Questionnaire-short form.***

As far as Group A is concerned, we can see an improvement in test results both at T1 and T2. As for Group B, we have a slight improvement between T0 and T1, but this is not kept in the T2 rating.

## **3 Discussion**

### **Postural evaluation with RAROG**

We can state that physical activity associated with a "healthy" environment has positively influenced the postural attitude of Group A subjects, partially correcting the existing paramorphism, as opposed to what happens in Group B.

### **Bio-impedance data**

Group A show how physical activity positively influences body composition. Decreasing results obtained through good physical activity tend to decrease if it is not perpetuated over time. The results of group B demonstrate that a sedentary lifestyle not allow the body to improve its condition.

### **Dental parameters**

In Group A, there is a general improvement in the values of indexes from T0 to T1; this can be directly attributed to the greater use of toothbrush and dental floss during this period, which are used on average once a day more compared to T0. The amount of stimulated saliva, after 3 months of physical activity, has an average volume greater than that observed at T0, and ranges from 3.4 ml to

6.48 ml this indicating a greater body homeostasis. Between T1 and T2, after the month of interruption of physical activity, we find a much less marked improvement of all parameters. The brushing frequency and the use of the interdental floss for oral hygiene remained unchanged, as did the plaque index. Lack of physical activity, for example, greatly reduces the swelling capacity of saliva; in fact, after the net improvement between T0 and T1, there is a decrease in 40% of the cases. In control group B, small changes can be found both in negative and positive, but mostly all values remain unchanged.

#### **Anthropometric parameters**

In Group A, with regard to weight data, B.M.I. and anthropometric measurements, we notice a data trend compatible with an increase in muscle mass from T0 to T1. However, these results are partially maintained at (T2) follow-up, i.e. after 1 month of suspension from physical activity. Regarding Group B, these data remain virtually unchanged both at T1 and T2.

#### **Evaluation with Digit Span Test and Q-LES-Q-SF**

Results emerging from the Digit Span Test show how physical activity positively influences short term memory and therefore concentration, and that this influence does not cease at the end of the activity being carried out. Assessments made through the Q-LES-Q-SF show us how to perceive the best quality of life in people who are living well in a "healthy" context. These results make us understand how to positively modify the physical sphere through physical activity, nutrition and oral hygiene, and the environment, there is a positive influence on the cognitive sphere and perception of the quality of life.

## **4 Conclusions**

Well-being is a general term that encompasses the entire universe of human life, including physical, mental and social aspects, which constitute what can be called a "good life". The precise and real definition of a "good quality of life" relates to the self-perception that everyone holds. As shown to a certain extent by our experimental study, quality of life is positively influenced by a healthy lifestyle, characterized by physical activity, nutrition and correct oral hygiene, affecting overall on anthropometric, postural and oral health parameters, thus improving the bio-psycho-social status of subjects undergoing experimental protocol. Several factors may positively or negatively change the health of a population. Health, in fact, is the result of a series of social, environmental, economic and genetic determinants and not the simple product of a healthcare organization. In this context, the role played by healthcare professionals, who must deal with health also in terms of lifestyle (e.g.

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physical activity as primary, secondary and tertiary prevention), and therefore consider the person in his broad context, even with regard to age and social context. Further studies are needed in order to involve a numerically larger population, so as to verify whether the statistical analyzed significance is changing with regard to the number of subjects recruited for the study. In addition, it would be useful to differentiate the technical characteristics of training in order to evaluate which type of activity is best for modifying certain parameters (dental, physical, social, etc.).

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