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SunKrist Sports Medicine and Research Journal

Review Article *Volume: 1, Issue: 1* *Scientific Knowledge*

The Impact of Lifestyle Changes on the Quality of Everyday Life of People with Osteoporosis

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1. Abstract

Osteoporosis has recently "walked in” like an epidemic. It is a disorder that, due to industrialization and the application of new technologies, is today present in younger people lives. Modern devices used in everyday life have replaced the physical activity of man, and along with the sedentary lifestyle, had an impact on an increasing number of people affected by this disease.

The effects of osteoporosis are significant because they represent a medical and social problem, and the cost of treating fractures requires significant economic expenditures [1,2]. Falls and injuries caused by them (e.g. fractures) are a growing problem for people in the third age group. Injuries and fractures cause pain plus functional disability, which consequently diminish the quality of life. The consequences increase costs of health care and cause mortality [3].

2. Methods and materials

The study was attended by 92 respondents, divided into the test study group A (46 subjects) and the control group B (46 subjects).

The test group (group A) consisted of subjects who were submitted to medication therapy and were taking vitamin D capsules for at least a year as part of their osteoporosis treatment. They were also performing Tae Bo exercises. The subjects conducted the exercises three times a week for 45 minutes, under supervision of Master of Physiotherapy who was also taught Tae Bo. In order to better monitor group (A) during their practices, the participants were divided into three smaller groups (one group counted 15, the other 16 respondents and the third 15 respondents). Each group followed the same exercise program that lasted and was run for 45 minutes. The control group (group B) exercises included walks lasting 45 minutes. The examinees walked three times a week for a year. At the beginning and the end of the study DEXAs, laboratory calcium (CA) blood and urine lab test, phosphorus (P) and vitamin D, and BMP, ALP and bone destruction markers measurements were performed in the Vukovar hospital laboratory. Based on the results of densitometry at the beginning and at the end of the study, a ten-year risk of fracture with the FRAX questionnaire was calculated along with the Quality Questionnaire of the European

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Received Date: July 31, 2020; **Accepted Date:** August 1, 2020; **Published Date:** August 18, 2020.

Foundation for Osteoporosis (QUALEFFO 31 questionnaire).

The SPSS for Windows (version 20.0, SPSS Inc., Chicago, Illinois, USA) and Microsoft Excel Statistical Analysis Tool (version 10 of Microsoft Corporation, Redmond, WA, USA) were used for statistical analysis of data. For the analysis of the results we used the following statistical methods:

For the continuous variables, the distribution symmetry was assessed by the Shapirio-Wilk test in order to see whether there was a statistically significant deviation from the normal Gaussian distribution, while the median and interquartal range was used for the mean dispersion measurements [4].

3. Results and interpretation of the obtained research values

Table 1. Summary of the initial and the final assessments of FRAX values in the subjects taught Tae Bo exercises (Group A and B).

Group A	FRAX-hip Initial Score	End Score	Change in Score	Change in Score*	Group B	FRAX-hip Initial Score	End Score	Change in Score
# of Smokers	19/46	-	-	-	# of Smokers	11/46	-	-
Mean	2.8	2.4	-0.38	-0.34	**Mean**	2.8	2.6	-0.18
Max	6.9	5.1	0.1	0.10	Max	5.2	5.0	0.20
Min	0.6	0.4	-1.80	-1.4	Min	0.7	0.5	-1.20
st. dev.	1.39	1.18	0.38	0.32	**st. dev.**	1.32	1.24	0.24
Skewness	0.79	0.57	-2.01	-1.7	Skewness	0.32	0.28	-1.77
Kurtosis	0.49	-0.21	4.8	3.87	Kurtosis	-1.02	-0.94	6.18
p-value of change in T-score			0.162	0.139	**p-value of change in T-score**		-	0.232
*Outlier Removed								

Out of the total number of subjects in group A, 19 are smokers. At the beginning of the study, the minimum FRAX score for group A subjects ranged from 0.6 to a maximum of 6.9, while the mean FRAX score of group A was 2.8, with a standard deviation of 1.39. At the end of the research, the FRAX score values characteristics were as follows: the minimum value was 0.4 and a maximum of 5.1; with mean value of group A of 2.4 and standard deviation of 1.18.

Analyzing the initial and final data, we note a change in mean values and their corresponding standard deviations. The "p" value of the change in the mean value reads 0.162, which strictly speaking falls just short of being statistically significant (typically one requires “p” value to be below 0.10, a milder form of statistical significance, and below 0.05 in the strictest form). For a complex (multi-factor) indicator such as FRAX, which is also impacted by a number of subjective measurements, the value of 0.16 is definitely worth noting and could be considered as quite a solid result (almost significant). One more point to note is that the FRAX analysis above also includes a subject whose FRAX value is greater than 6, an outlier. If this FRAX point is excluded from the analysis, justifiable on the basis of being such an outlier within the whole sample, a p value of 0.139 is obtained. Again, the result is strictly speaking not statistically significant, but it further reinforces the notion of a positive change in the ten-year risk of fracture for group A. The measurement was eliminated for a subject with the initial FRAX of 6.9 and whose FRAX score decreased by 1.8 to 5.1 (one of the best improvements in group A). It is also important to note that large deviations, asymmetry and fat-tails significantly contribute to elevating standard deviation (i.e. the measurements are more dispersed) and are therefore negative for the "p" value. As earlier indicated, the "p" value is limited to the assumption of normal distribution. This limitation is best illustrated in the previous discussion on

improving the "p" value when one of the best points is taken out, the subject with FRAX of 6.9 (and the change of 1.8). So, the above criticism of the 0.162 of the "p" value as not significant should be "taken with grain of salt".

The following is the summary of group B data set and the analysis of the calculated FRAX score. The group consists of 11 smokers. At the start of the study the FRAX figures read as at the list:

The minimum FRAX value was 0.7, the maximum 5.2, with a mean value of 2.8 and a standard deviation of 1.32. At the end of the research study the minimum FRAX value for group B was 0.5, the maximum was 5.0, while the mean value came at 2.6 with a standard deviation of 1.24. We note the changes in the minimum, maximum and the mean value as well as in the standard deviation. However, the "p" values of the changes do not show any statistical significance.

Comparing the FRAX results of group A (test group) and group B (control group), strictly speaking, both groups exhibit a suboptimal level of statistical significance.

Nevertheless, as analyzed earlier, group A results are statistically much stronger, coming only a tad below the significance threshold. In addition, when visually comparing the results, it can be seen that in group A there is definitively a positive progress, a much harder claim to make for group B.

Table 2. shows the initial and final values of vitamin „D" group A .

Group A	Vitamin D		
	Initial Score	**End Score**	**Change in Score**
Number	46	-	-
Mean	44	53	8
Max	62	79	24
Min	32	33	1
st. dev.	8.14	9.67	5.42
Skewness	0.48	0.36	0.9
Kurtosis	-0.55	0.15	0.75
p-value of change in vit. D			0.061

Vitamin D has an important role in calcium resorption from food, and its shortage is an important indicator of the possibility of osteoporosis. Analysis of its values comes from serum and their normal range limits range from 50.0 to 200.0 nmol / L.

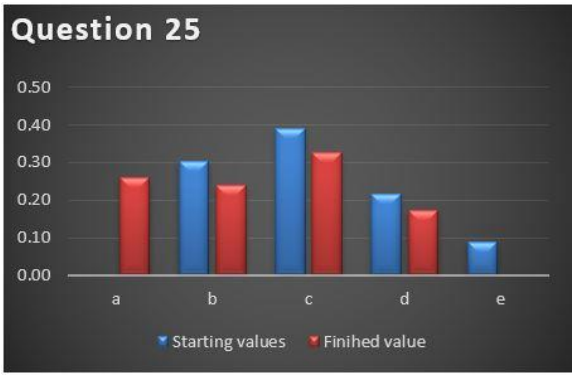
Initial values of vitamin D in group A respondents range from a minimum of 32 nmol / L to a maximum of 64 nmol / L with a mean value of 44 nmol / L and a standard deviation of 8.14. At the end of the study, minimum values of A group of 33 nmol / L to maximum 79 nmol / L, with a mean value of 53 nmol / L, were determined with a standard deviation of 9.67. The calculated "p" value of 0.061 and similar represents a statistically significant difference within group A. While the lower limit ("min") remained virtually unchanged, it is important to notice that the upper ("max") and mean values were visibly increased (" max "value jumped from 62 to 79).

Table 3. shows the initial and final values of vitamin „D" group B.

Group B	Vitamin D		
	Initial Score	**End Score**	**Change in Score**
Number	46	-	-
Mean	45	51	5
Max	68	72	11
Min	30	36	0
st. dev.	9.14	9.47	2.74
Skewness	0.38	0.36	0.23
Kurtosis	-0.4	-0.64	-0.60
p-value of change in vit. D			0.026

Among the group B respondents in initial vitamin D analyzes, the values ranged from a minimum of 30 nmol / L to a maximum of 68 nmol / L with a mean of 45 nmol / L and a standard deviation of 9.14. By comparing these results with the results of group A, it can be observed that the minimum initial values of group A are higher at the beginning of the measurement, while the maximum initial values are higher in group B. At the end of the study, the minimum vitamin D value of 33 nmol / L for group B is higher than the minimum vitamin D value for group A, whereas the maximum value of vitamin D of group B is 72 nmol / L which is lower than the same value in group A. Also, there is a difference in the lower

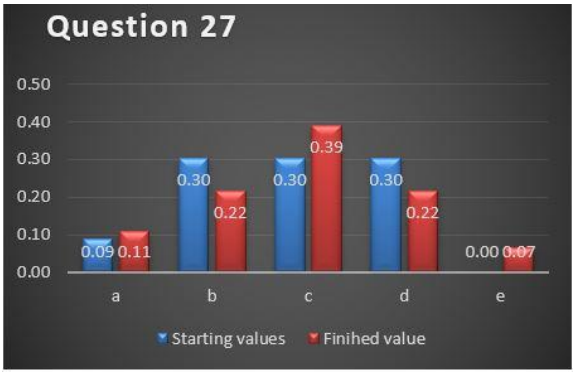
mean of the group 51 of 51 nmol / L. Looking at the change in the "p" value of group B respondents it definitely measures 0.026 and as such represents a statistically significant difference between initial and final measurements.



Graph 1 shows the distribution of the answers of group B to question 25 QUALLEFFO 31 questionnaires from "do you feel downhearted?".

For group B respondents to question 25 - “do you feel downhearted?” the answers at the end of the survey showed that 25% felt depressed almost daily, 22% felt that way three to five times a week, 35% of group B respondents felt disheartened once or twice a week, while 18% responded with only occasionally.

Comparing the final answers of Group A and Group B respondents, they show little difference except for 7% of Group A respondents who almost never feel downhearted.



Graph 2 shows the distribution of the answers of group A to question 27 QUALLEFFO 31 questionnaires from “do you feel full of energy?” - a - almost every day b - 3 to 5 times a week c - 1 to 2 times a week d - from time to time e - almost never.

Question 27 is a question asked by the respondents 'do they feel full of energy?'. The final answers of Group A respondents show that 11% percent feel dynamic almost daily, 22% stated that they feel full of energy three to five times a week, 39% of respondents feel energetic from time to time, and 7% once a week.

4. Discussion

Though twenty years ago, osteoporosis most commonly affected ages over 65 years, research in recent years has shown that age limit for the onset of osteoporosis is shifting towards a younger age, both in developed and developing countries [5]. Former researches have shown that aging brings a higher likelihood of fracture, more frequent depressive mood and lower concentration of vitamin D in the body.

The average age of the participants in the study was 63.1 and each of them had been diagnosed with osteoporosis for more than a year, which confirms the theory that osteoporosis occurs at an older age, although there were16 people aged 55 and over with osteoporosis who participated in the study. Similar experiences were described in a study conducted on 290 women at the Mayo Clinic reported by Pecina et al in 2016, confirming that the subjects had osteoporosis and their average age was 56.6 years [6]. FRAX questionnaire was approved in 2008 by the WHO to assist health professionals in the prevention of osteoporosis, whose completion calculates a 10-year fracture risk in the hip area and the risk of a general fracture. For the purpose of this study, FRAX was used to assess the ten-year risk of fracture in the hip area, considering the fact that the mean age of the subjects was 63.1 years, when hip fractures were most commonly experienced [7]. Numerous studies have reported the harms of smoking and the poor impact of nicotine on estrogen and testosterone function, resulting in a decrease in bone calcium and a greater likelihood of osteoporosis. In one research the study included a subject who also had chronic obstructive pulmonary disease and it could not be determined with certainty what influenced the occurrence of a fracture of the femoral neck [8]. Among the respondents in this study, out of 92, there were 30 smokers. Of these, 19 were Group A and 11 were

Group B. By calculating the FRAX questionnaires for each individual and analyzing the data, it could be seen that if a person is a smoker, he or she is ten times more likely to have a fracture than the same or similar values in a person, who is a non-smoker [9]. This study conducted and analyzed the FRAX questionnaire among female respondents, and its results showed that there was better progress in Tae Bo exercise subjects in terms of reducing the ten-year fracture risk, although the "p" value resulting from the analysis of initial and final results is not statistically significant. However, given that the FRAX hip of the whole group A was calculated and analyzed, it must be emphasized that the result was influenced by the large number of female smokers, because in this group there are almost twice as many female smokers compared to the group B. The FRAX values of the hip of Group B subjects are expected to get worse, although in this group there is positive progress in terms of lowering the risk of fracture, but the "p" value of this group does not show statistical significance [10]. The use of the FRAX questionnaire also identified shortcomings that could significantly affect the result of the fracture risk assessment. The shortcoming is related to the information we get from the respondents, and the questions are related to alcohol consumption, whereby an answer that is not "correct" can significantly change the outcome of the risk assessment result itself. Also, one of the negative sides of the FRAX questionnaire is that it is not recommended to be used before the age of 40, since the age limit for osteoporosis is continually lowering, because of the modern way of life, stress, and earlier start of menopause. It would be important to understand that even before the age of 40 a FRAX questionnaire could be used as a tool for assessing fracture risk. Recent research has suggested the importance of Vitamin D for the whole organism, and especially for the bone system [11]. If vitamin D is represented in the body as 25 (OH) D in insufficient concentration from normal 50 to 200 nmol / L, it results in insufficient absorption of calcium in the small intestine [12]. Reduced calcium concentration results in increased probability of bone breakdown. Studies conducted by Mithal and Lips underlined that the highest vitamin D deficiency is present among South Asian people, while a severe vitamin D deficit has also been reported in southern Europe [13]. According to Laktašić-Žerjavić data from 2014, a severe vitamin D deficit is present in the Republic of Croatia, notably as many as 79% of the respondents have a concentration of 25 (OH) D <of 75nmol / L, and according to these data the results are much worse than in other European countries [11]. The subjects who participated in this study had vitamin D deficiency, and their baseline values ranged from a minimum of 32 to a maximum of 62 nmol / L for group A subjects, and from 30 to 68 nmol / L for group B subjects. A year before the start of the study, all subjects consumed aldronate and Vitamin D and better baseline values were expected in their therapy. Upon completion of the study, by repeating the laboratory findings of vitamin D, it could be observed that a statistically significant "p" value was recorded in both groups of subjects, which was attributed to the combination of therapy and physical activity of both groups. More recent studies confirm that the most effective way to treat osteoporosis is regular consumption of vitamin D, medication therapy, a diet enriched with calcium and other elements important for firm bones, and particularly regular exercise [14]. Analyzing the answers given at the end of the study among the respondents, it can be observed that in the category of mental functions of nine answers, eight show a statistically significant change, for both groups with the difference, for example, whether you feel full of energy in the respondents who practiced Tae Bo. There was a statistically significant change at the end of the study, whereas no such change was observed in walking women.

At the end of the study, the subjects of group A who practiced Tae Bo were asked to comment on their

impressions regarding the 12 months of Tae Bo exercise. After the diagnosis of osteoporosis, all the respondents came to physical therapy and medical exercises to the Physical Therapy and Rehabilitation Department at OZB Vukovar, and then learned the medical exercises that they should continue later in their own home after the completion of the therapeutic process. Group A respondents indicated that their medical exercises performed during the rehabilitation procedure appeared to be insufficiently effective regarding their age (especially in the 55-60 age group, given that they were all working women), and that their exercises seemed monotonous and consequently they did not find a motive strong enough to continue practicing in their own home. Unlike medical exercises, they rated Tae Bo exercises as the type of exercise that allowed them to have a better quality of life over two months of exercise, i.e. through 24 exercise sessions.

Group A respondents indicated that after several encounters, they felt more mobile and were surprised by their greater range of motion and some of the movements they had been unable to perform for years (eg, at the beginning of the survey of 46 women, only five of them could sit down without the help of hands or other movement patterns compared to the fact that at the end of the study, there was only one respondent who could not sit up from the lying position). Furthermore, exercising in a group of women with similar problems showed them that they were not alone, and that osteoporosis as their problem, through exercise, brought socializing, meeting other people with similar problems, sharing experiences, and above all, brought about a life with much less pain, nightdream not interrupted by pain and days that were not filled with fears of some uncertainty and fear of falls and fractures. And something that is by no means negligible, this is certainly the case that this category of women - women with osteoporosis found their place where they regularly felt exercised under professional supervision. They identified their workouts with healthy lifestyle training rather than illness and medical exercises. Perhaps the best confirmation of how much better their quality of life was, compared to the quality of life that respondents had had before attending Tae Bo's exercise, is that after completing the study, they continued to exercise three times a week the way they had done exercises conducted during the research.

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Citation: Slavica Janković. The Impact of Lifestyle Changes on the Quality of Everyday Life of People with Osteoporosis. SunKrist Sports Med Res J. 2020; 1: 1001.