

Effects of combined aerobic, aqua aerobic and swimming program to some morphologic characteristics and motoric abilities in elderly women

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Abstract

Research has been done on the sample of 20 elderly women ($n=20$, mean age= 67.0 ± 5.9 yrs; mean height) 1.63 ± 0.12 m; mean weight) 75.3 ± 15 kg) who had been involved in experimental combined twenty-weeks training program, twice a week, for 60 minutes. Research goal was to state the effects of combined aerobic, aqua aerobic and swimming program to some morphologic characteristics at the beginning and at the end of the program, as well as based on significance of changes tested by T-test for reliant samples, it could be seen that the program caused certain changes in some morphological variables. It comes about body weight ($p=.001$), waist size ($p=.000$) and size of thorax at inhaling ($p=.000$). Test results point that statistically important changes occurred in motoric space at testing speed of making individual move by arm ($p=.000$), coordination in space ($p=.000$), flexibility in banding forward ($p=.000$), as well as speed in 50 meters distance swimming ($p=.000$). Applied training-exercising program which included the said movement activities proved to be efficient, because it was confirmed that it positively affects some morphological characteristics and improvement of capability, mobility, coordination and flexibility in senior age women.

Keywords: **women, elderly age, aerobic, aqua aerobic, swimming, morphologic characteristics and motoric abilities**

Sažetak

Ispitivanje je rađeno na uzorku od 20 žena starije životne dobi ($n=20$, mean age= 67.0 ± 5.9 yrs.; mean height= 1.63 ± 0.12 m; mean weight= 75.3 ± 15 kg) koje su bile uključene u eksperimentalni kombinovani program vježbanja u periodu od 20 sedmica, dva puta sedmično po 60 minuta. Cilj istraživanja bio je utvrditi efekte kombinovanih programa aerobica, aqua aerobica i plivanja, na neke morfološke karakteristike i motoričke sposobnosti kod žena u starijoj životnoj dobi. Na osnovu aritmetičkih sredina rezultata na početku i na kraju programa, kao i na osnovu značajnosti promjena testiranih T-testom za zavisne uzorke, može se vidjeti da je program izazvao određene promjene u nekim morfološkim varijablama. Radi se o tjelesnoj težini ($p=.001$), obimu struka ($p=.000$) i obimu grudnog koša pri udisaju ($p=.000$). Rezultati testova ukazuju da je došlo do statistički značajnih promjena u motoričkom prostoru pri testiranju brzine izvođenja pojedinačnih pokreta rukom ($p=.000$), koordinaciju u prostoru ($p=.000$), fleksibilnost u pretklonu ($p=.000$), kao i brzine plivanja na 50 metara ($p=.000$). Primjenjeni program vježbanja, koji je obuhvatio spomenute kretnosti, pokazao se efikasnim, jer je potvrđeno da pozitivno djeluje na neke morfološke karakteristike i poboljšanje spretnosti, okretnosti, koordinacije i fleksibilnosti u poznim godinama kod žena.

Ključne riječi: **žene, starija životna dob, aerobic, aqua aerobic, plivanje, morfološke karakteristike i motoričke sposobnosti**

Introduction

New theories on phases of human life include ageing as overall development of human being and a kind of challenge that instigates knowledge on improvement of health and psychological benefit with elderly people (Spencer, Ruthus, 2000). Ageing leaves traces on motoric functions, and it is more frequently manifested in decrease of both strength and muscular mass. This leads to damage of mobility and activities in everyday life (Murata, 2009). The age of 65 is taken in the most of developed countries as reference value for elderly age which is marked by a number of changes both in functioning of organism as well as in socio-economic relations. Arising changes are significantly reflected in movement activities and they affect motoric abilities. Strength, endurance, muscular mass and bones density are significantly reduced, and quantity of sub-dermal adipose tissue increases (Adams et al., 1999). Researches proved that loss of muscular strength and muscular mass are one of the most visible and notable changes that take place with elderly people. In addition, progressive destruction of nerve system as result of aging process has significant effect on structure and function of nerve-muscular system and work of muscles themselves (Bellew, 2002). During the process of ageing, changes in bone-joint system take place, as well as in skeleton muscles, blood, cardiovas-

cular system and basal metabolism (Andrijasević, 1996). Some authors believe that physical training should be done from early youth to late old age. Every man should build up the healthy basis for active getting old with the preservation of functional ability and health improvement in late ages (Torlaković et al., 2010). This is one of very important factors having favorable impact on bone density level, and later, on preservation, postponing, emersion and extent of osteoporosis. It also reduces possible fracture risks, particularly with women following menopause (Khan, 2001). On the basis of some researches treating this issue, it was found out that during ageing process, reduction of motoric units takes place resulting in loss of muscular fibers of type I and type II. Also, reduction of horizontal cross-section of muscular tissue takes place, particularly on type II muscular tissue which results in reduction of mass and strength of muscles (Adamo et al., 2006). Presently, exercises for increase of strength through aerobic component and flexibility component are important part of recommended training-exercising program for preserving and improvement of health and prevention of chronic diseases with adults and elderly people (Misigoj Duraković et al., 2008). In some researches, dealing with such population (Barbarose et al., 2002), it was proved that strength training has positive effect on

development of flexibility with elderly women. While researching use of swimming, aerobic and dancing programs three times a week for 30 to 60 minutes, it was concluded that the said activities had positive effects on reducing of breast and colon cancer (Lee, 2003).

While analyzing effects of the program, which is implemented in elderly population (Freigenbaum, 1999; Fleg, 2005), it was concluded that elderly people are population that can have major benefit from regular and moderate physical activity. It is interesting that data prove that elderly people, who regularly exercise, have stronger immunity system than those who do not exercise although they are younger (Ogawa et al., 2005). Therefore, it can be stated that maintenance of vital functions of organism at optimum level is a precondition for health and consequently for good mood, feeling of efficiency, optimism and quality of life (Andrijasević, 2007). Goal of this article is to establish effects of combined aerobic, aqua aerobic and swimming program to morphological characteristics and motoric abilities of the women in elderly age.

Methods

Sample of examinees

Research has been done on the sample of 20 women included in experimental training program (n= 20, mean age=67,0±5,9 yrs.; mean height= 1,63±0.12m; mean weight= 75.3±15kg). Criteria was that before the beginning of program, all participants should have medical check based on which physician could provide his/her professional opinion and agreement that they can be included in combined training program of aerobic character and moderate intensity.

Sample of variables

In research, a modified battery of tests (Kurelić et al., 1975; Mikić, 1999; Radjo, 1997) has been applied for evaluation of some morphological characteristics, some motoric abilities and successfulness in swimming (Table 1).

Table 1. Sample of variables

| Variable | Test | Measured capacity | Measuring unit |
|----------|--------------------------------------|--|----------------|
| ATT | Absolute body weight | Volume of the body | kg |
| OBS | Scope of waist | Volume of the body | cm |
| ONK | Scope of thigh | Volume of the body | cm |
| ONL | Scope of upper arm | Volume of the body | cm |
| OGKI | Scope of thorax - exhalation | Volume of the body | cm |
| OGKU | Scope of thorax - breath | Volume of the body | cm |
| TPR | Arm/hand plate tapping - 20 repetit. | Assessment speed of alternate movement | seconds |
| DOH | Forward/flexibility front bench bent | Assessment of flexibility | cm |
| KOR | Movement/mobility | Co-ordination assessment body movement | seconds |
| SP50M | Swim 50 meters freestyle | Success in swimming | seconds |

Method of results processing

T-test for reliant sample (differences are significant at $p < ,05000$) has been used for analysis of results of initial and final testing.

Methodology of exercising program

Overall program has been accomplished in the Olympics Pool Sarajevo in the morning hours. The activities were performed over the period of twenty weeks, twice a week, for 60 minutes. Aerobic program was been implemented in the sports hall with adequate ground-base and tools, aqua aerobic exercises in slightly sloppy, 110 cm deep pool, and swimming program in 25x50 meters long and 220 cm deep pool. Training has been performed in groups of 10 attendants with professional leading and supervision by sports and physical training teachers. The attendants have not been requested to change their regime and way of cuisine.

Candidates have been instructed and advised as follows:

- Not to start swimming and exercising program if they did not feel ready and healthy
- Not to swim if hungry or with full bally
- The last meal should be at least two hours prior to any activity
- While changing from training aerobic in pool they should make an adequate break and adapt organism for further activity as to avoid unwanted consequences
- Immediately get out of water in case of spasm, stretch muscles in question and relax

Table 2. Implementation of program contents per weeks

| Program/Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | TOTAL HOURS | |
|--------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|-------------|-----|
| Swimming | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 10 |
| Aqua aerobic | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | * | 10 |
| Fitness | * | * | | | * | | | * | | | * | | | * | | | * | | | | | 3 |
| Aerobic low | * | | | * | | | * | | | * | | | * | | | * | | | * | | | 3,5 |
| Step aerobic | | | * | | * | | | * | | * | | * | | * | | * | | * | | * | | 3,5 |
| Pilates | | | * | | * | | | * | | * | | * | | * | | * | | * | | * | | 3,5 |
| Dancing | * | | | * | | | * | | | * | | * | | * | | * | | * | | * | | 3 |
| Streching | | * | | | * | | | * | | * | | | | * | | | * | | * | | | 3,5 |

Table 3. Division of lesson per stages

| Stage of the lesson | Introductory-preparatory | The main "A" | The main "B" | Completion |
|---------------------|--------------------------|--------------|--------------|------------|
| Duration | 5-10 % | 40-45% | 40-45% | 5-10% |

Each lesson of the program consists of four stages. Warming exercises 5-10 minutes, aerobic type exercises on the ground 20-25 minutes, then 20-25 minutes of aerobic type training in water (free style swimming or aqua aerobic) and 5-10 minutes of relaxing and soothing of organism. During each lesson, introductory-preparatory, and main "A" stage has been done on the ground, and main "B" phase has been done in water (table 2 and 3).

Results and Discussion

On the basis of arithmetic mid result at the beginning and at the end of program, as well as on the basis of importance of changes tested by T-test for reliant samples, it could be seen that the program caused certain changes in some morphological variables. It comes about body weight (ATT $p = .001$), waste size (OBS $p = .000$) and size of thorax at inhalation (OGKU $p = .000$). Test results show that statistically significant changes in motoric space occurred. This refers to speed of making individual moves by arm (TPR $p = .000$), coordination while making complex moves (KOR $p = .000$) and flexibility in bending forward (DOH $p = .000$). All test participants during final testing have swam 50- meters section faster than at the beginning of the program (SP50M $p = .000$). Program did not have significant effect on size of upper leg, lower leg and thorax at exhale (table 4.)

Table 4. Importance of morphological characteristic under effect of program

| | Mean | Std.Dv. | N | Diff. | Std.Dv. Diff. | t | df | p |
|---------|-------|---------|----|-------|------------------|--------|----|-------------|
| ATT 1 | 76,65 | 8,845 | | | | | | |
| ATT 2 | 75,3 | 8,633 | 20 | 1,350 | 1,565 | 3,857 | 19 | ,001 |
| OBS 1 | 96,55 | 9,472 | | | | | | |
| OBS 2 | 94,35 | 9,421 | 20 | 2,200 | 2,041 | 4,818 | 19 | ,000 |
| ONK 1 | 56,4 | 3,633 | | | | | | |
| ONK 2 | 56,1 | 3,582 | 20 | ,300 | 1,128 | 1,188 | 19 | ,249 |
| ONL 1 | 31,45 | 2,723 | | | | | | |
| ONL 2 | 31,25 | 2,572 | 20 | ,200 | ,9514 | ,940 | 19 | ,358 |
| OGKI 1 | 99,55 | 5,986 | | | | | | |
| OGKI 2 | 99,65 | 5,94 | 20 | -,100 | ,4472 | -1,00 | 19 | ,329 |
| OGKU 1 | 103,2 | 5,618 | | | | | | |
| OGKU 2 | 104 | 5,666 | 20 | -,750 | ,9104 | -3,683 | 19 | ,001 |
| TPR 1 | 12,7 | 1,809 | | | | | | |
| TPR 2 | 10,7 | 1,625 | 20 | 2,000 | ,8583 | 10,419 | 19 | ,000 |
| DOH 1 | 37,95 | 13,1 | | | | | | |
| DOH 2 | 25,45 | 11,17 | 20 | 12,50 | 7,337 | 7,618 | 19 | ,000 |
| KOR 1 | 51,85 | 14,57 | | | | | | |
| KOR 2 | 45,8 | 10,75 | 20 | 6,050 | 4,882 | 5,541 | 19 | ,000 |
| SP50M 1 | 115,7 | 35,59 | | | | | | |
| SP50M 2 | 107 | 34,43 | 20 | 8,700 | 3,743 | 10,394 | 19 | ,000 |

As it could be seen, the results of the research (Figure 1 and 2), use of aerobic programs that were used in this research show that exercises in water, combined with other aerobic programs, can effect change in mass of the body. Test participant reduced their body weight by 1,3 kg, in average. As result of reduction of body weight, waste size has been reduced by 2,2 cm in average (figure 1 and 2). These data partially confirm the results of similar research (Hoeger et al., 1999; Michaud et al., 1995) by which it was proved that use of program of similar characteristics, but higher frequency of lessons, has significant effect on body fat in untrained healthy test participants.

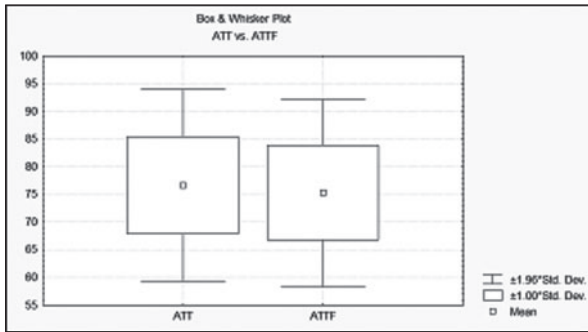


Figure 1. Absolute body weight (Initial vs. Final)

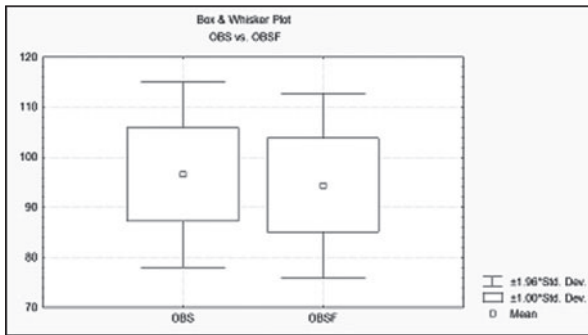


Figure 2. Scope of waist (Initial vs. Final)

Also, under the influence of aerobic training, changes occurred also in solid increase of size of thorax at inhaling (figure 3). On the basis of these data one could say that aerobic training program had positive effect on lung ventilation, so that test participant had somewhat larger size of thorax in final testing (average of 0,75 cm) rather than at the initial measuring.

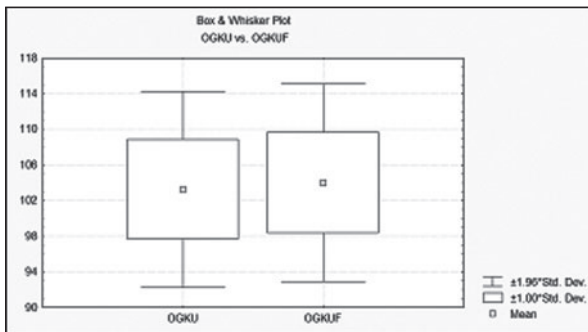


Figure 3. Scope of thorax – breath (Initial vs. Final)

Results of “hand tapping” test show that in final testing, test participants significantly improved nerve-muscular contractions and had, in average, 2 seconds faster frequency of individual arms movements (Figure 4).

It is important to emphasize improvement in flexibility in bending in all test participants, which confirms results of earlier researches, which tested effects of training in water in elderly women (Colado et al., 2009; Bocalini et al., 2008; Ruoti et al., 1994; Hoeger et al., 1992). As result of the program, test participants improved their flexibility in bending by 12,2 cm. This data proves that program caused significant positive effects to enhancement of this motoric ability (Figure 5).

By use of “slalom with three balls” test one could see that all test participants significantly improved coordination while making complex moves (Figure 6). Average improvement in time that is needed for carrying out of this test was about 4,8 seconds. These data show that program instigated significant, positive changes regarding coordination, which can have strong effect to preservation of health and quality of life of elderly women, thus confirming results of similar researches (Deley et al., 2007; Tsourlou et al., 2006) on effects of physical training on elderly persons.

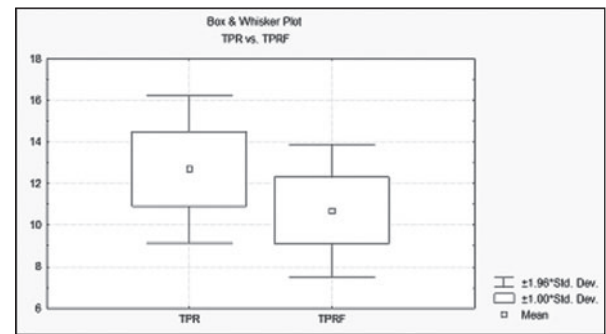


Figure 4. Arm/hand plate tapping – 20 repetit. (Initial vs. Final)

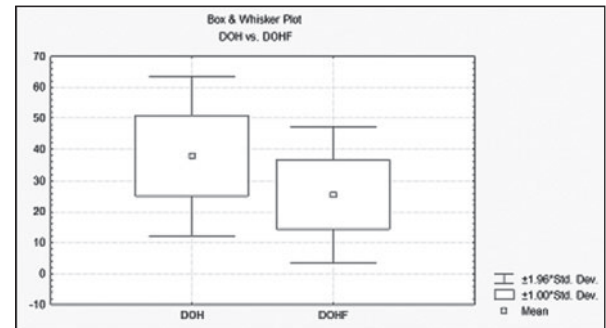


Figure 5. Forward/flexibility front bench bent (Initial vs. Final)

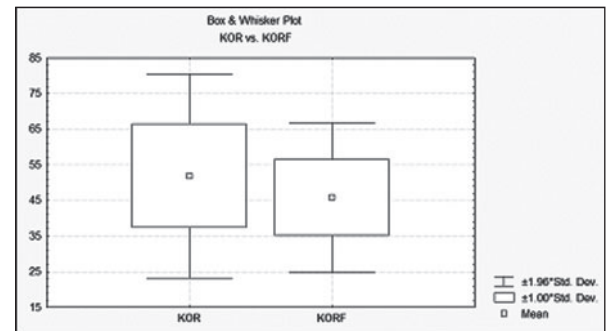


Figure 6. Swim 50 meters freestyle (Initial vs. Final)

On the basis of arithmetical mid results at the beginning and at the end of program as well as on the basis of changes tested at univariate level (Figure 7), it is evident that swimming program pro-

duced, apart from partial effects, also significant global effects. All test participants significantly improved time they needed to cross 50 meters section swimming free style (average improvement was 8,7 seconds). Such result in enhancement of swimming speed was expected, because it comes about untrained persons who were additionally trained in technique of movement in water. Indeed, such kind of combined training had impact on strengthening of muscles of the whole body, improvement of aerobic endurance, which results in improvement of time and skillfulness in swimming.

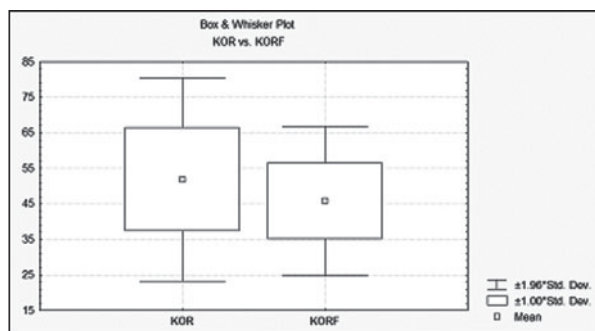


Figure 7. Movement/mobility (Initial vs. Final)

Conclusion

From medical and kinesiological point of view, the fact has already been known that swimming and training in water are listed as the most appropriate movement activities. In the research, we applied experimental program of versatile and moderate training of aerobic character for 20 weeks period. As it could be seen from comparison of similar researches so far, any person during the youth should start creating grounds for healthy active ageing with maintaining functional abilities and promotion of health in the old age. Combined program of body training applied in the research, which included the said movement activities proved to be efficient, because it was proved that it positively affects improvement of skillfulness, agility, coordination and flexibility in elderly age of the women. Results of implemented program showed that with appropriate stimulations under impact of swimming, aqua aerobic and aerobic program one could have positive outcome to some morphological characteristics with this population. Having in mind significant positive effects of aerobic training, probably the best recommendation for old persons is just combination of strength trainings and activities in various aerobic programs that increases endurance. Just these abilities allow them more quality lives and more efficient performance of everyday activities. As mentioned during discussion, this experimental program has proved, to some extent, results and conclusions of the authors of similar researches on effects of training to morphological abilities of elderly persons. It is confirmation that physical activity, as the way of life, is believed to be the most natural method and the most significant prevention factor for achieving and maintaining women's health in all its aspects. Therefore, the conclusion is that regular and moderate training in elderly age can increase quality of life and independence from other peoples' care. Finally, it can be concluded that combined program of exercises of aqua aerobic, aerobic and swimming significantly impact improvement and maintenance of adequate level of motoric abilities with elderly women, which indeed allows this population more quality life. Program can be used for education and animation of this population, so that they could take over personal responsibility and care for their health. In that way, by regular and moderate activities ageing processes and their negative effects are slowed down.

References

- Adamo ML, Ferrar R.P (2006). Resistance training, and IGF involvement in the maintenance of muscle mass during the aging process. *Ageing and research reviews* (5):310.
- Adams, K., Pi. O'Shea, K.L. O'Shea (1999). Aging: its effects on strength, power, flexibility, and bone density. *Journal of Strength and Conditioning Research* 21(2):65-77.
- Andrijašević, M. (1996). Sports recreation at working place and residence. (Sportska rekreacija u mjestu rada i stanovanja). Faculty of Physical Culture of the University of Zagreb
- Andrijašević, Mi., Ma. Andrijašević (2007). Sports recreation – factor of quality of life in elderly people. (Sportska rekreacija – faktor kvaliteta života osoba starije životne dobi) Croatia kinesiological Association, Journal of 16th summer school 16:266-270.
- Barbosa, A. R., Santarem, J. M., Filho, W. J. i Nunes Marucci, M. F. (2002). Effects of Resistance Training on the Sit and Reach Test in Elderly Women. *Journal of Strength and Conditioning Research* 16(1):14-18.
- Bellew, J. W. (2002). Older Adults and One – Repetition Maximum Testing: What About Injuries. *Journal of Strength and Conditioning Research* 24(1):60-62.
- Bocalini, D.S., Serra, A.J., Murad, N. and Levy, R.F. (2008). Water versus land-based exercise effects on physical fitness in older women. *Geriatric & Gerontology International* (8):265-271.
- Colado, J.C., Triplett, N.T., Tella, V., Saucedo, P. and Abellán, J. (2009). Effects of aquatic resistance training on health and fitness in postmenopausal women. *European Journal of Applied Physiology* (106):112-113.
- Deley, G., G. Kervio, J. Van Hoecke, B. Verges, B. Grassi, JM.Casillas (2007). Effects of a one-year exercise training program in adults over 70 years old: a study with a control group. *Journal Aging Clin Exp Res* 19 (4): 310.
- Feigenbaum MS, Pollock ML. (1999). Prescription of resistance training for health and disease. *Journal of Medicine Sci Sports Exerc* 31(1):38-45
- Fleg JL, Morrell CH, Bos AG, Brant LJ, Talbot LA, Wright JG, Lakatta EG. (2005). Accelerated longitudinal decline of aerobic capacity in healthy older adults. 674
- Hoeger, W.K., Gibson, T., Moore, J. and Hopkins, D. (1992). A comparison of selected training responses to water aerobics and low impact aerobic dance. *National Aquatics Journal Winter Edition*, 13-16.
- Khan, K.M., T. Liu-Ambrose, M.G. Donaldson, H.A. McKay (2001). Physical activity to prevent falls in older people: Time to intervene in high-risk groups using falls as an outcome. *British Journal of Sports Medicine* (35):144-145.
- Kurelić, N., K. Momirović, M. Stojanović, M. Ž. Radojević, N. Viskić-Štalc (1975). Structure and development of the morphological and motor dimensions of youth (Struktura i razvoj morfoloških i motoričkih dimenzija omladine). Beograd: FFV.

Lee, I.M. (2003). Physical activity and cancer prevention – data from epidemiologic studies. *Medicine & Science in Sports & Exercise* (35): 1823-1827.

Michaud, T.J., Brennan, D.K., Wilder, R.P. and Sherman, N.W. (1995). Aquarunning and gains in cardiorespiratory fitness. *Journal of Strength and Conditioning Research* (9):78-84.

Mikić, B. (1999). Testing and measurement in sport (Testiranje i mjerenje u sportu). Faculty of Physical Education University in Tuzla.

Mišigoj Duraković, M., Z. Duraković, B. R. Matković (2008). Strength training in the elderly. *Journal Croatian Sport-med.* (23):18-24

Murata, J., S. Murata, J. Hiroshige (2009). The influence of age-related changes in tactile sensibility and muscular strength on hand function in older adult females. Book of abstracts. 14th Annual Congress of the European College Of Sport Science, Norway. 82

Ogawa, K., J. Oka, J. Yamakawa, M. Higuchi (2005). A single Bout of Exercise Influences Natural Killer Cells in Elderly Women, Especially Those Who are Habitually Active. *Journal of Strength and Conditioning Research.* 19(1):45-50.

Radó, I (1997). Transformation process of motor and functional ability and various aspects of swimming. Doctoral thesis (Transformacioni procesi motoričkih i funkcionalnih sposobnosti i različitih aspekata u plivanju). Faculty of Physical Education University in Sarajevo.

Ruoti, R.G., J.T.Troup, R.A. Berger (1994). The effects of no swimming water exercises on older adults. *Journal Orthop Sports Phys Ther.* 19(3):140-145.

Spencer A. Rathus (2000). Foundations of Psychology (Temelji psihologije), Edition Slap, Zagreb

Torlaković, A., I. Radjo, S. Dautbašić, M. Gec (2010). Effects of combined programmes swimming, aqua aerobic and aerobic for elderly people. 6th International Conference "Movement and Health 2010" and 2nd HEPA Europe Conference. *Acta Universitatis - Gymnica* 40(3) 111

Tsourlou, T., B. Athanasia, D. Konstantina, A. Zafeiridis, K. Spiros (2006). The effects of a twenty-four-week aquatic training program on muscular strength performance in healthy elderly women. *Journal of Strength and Conditioning Research.* 20(4): 811-818

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