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## **INFLUENCE OF AEROBIC LOADS ON POWER INDICATORS OF DEEP NECK AND BACK MUSCLES IN PREGNANT WOMEN**

A.S. Batrak<sup>1</sup>, E.Yu. D'yakova<sup>2</sup>, L.S. Khodasevich<sup>3,4</sup>

<sup>1</sup>Sports and Health-Improving Center "Grow Together", Sochi, Russia

<sup>2</sup>National Research Tomsk State University, Tomsk, Russia

<sup>3</sup>Research Center of Balneology and Rehabilitation – Branch of FSBI

“North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency”, Sochi, Russia

<sup>4</sup>FSBEI of HE "Kuban State Medical University" of the Ministry of Health of the Russian Federation, Krasnodar, Russia

**Key words:** water aerobics, aerobics, pregnant women, aerobic loads, muscle strength indicators.

**Annotation.** Aerobic exercise during pregnancy helps to reduce the risk of complications, improving the health of the mother and baby. The study of the effect of aerobic exercises on the strength parameters of the deep muscles of the neck and back was carried out in 207 women with an uncomplicated obstetric history and uncomplicated pregnancy. Women were divided into 3 groups: the first (n=100) was engaged in water aerobics in the pool, the second (n = 57) – aerobics in the gym, the third (n=50) did not engage in systematic physical culture. The results of the study revealed that aerobic exercise during prenatal preparation of pregnant women has a beneficial effect on strength indicators of deep neck and back muscles. At the same time, the best results were obtained in pregnant women engaged in water aerobics.

**Introduction.** Motor activity of a woman during pregnancy contributes to not only the preservation of health of the mother and baby, but also the prevention of developing complications during the prenatal period, delivery and postnatally. Therapeutic exercises help a pregnant woman to strengthen the muscle system, increase the spine's mobility, obtain relaxation skills, learn respiratory gymnastics, prevent excessive weight gain, normalize tone and functioning of internal organs, improve psychoemotional state. It is achieved with aerobic loads and their combination with strength training sessions that include aerobic exercises [1-4].

Pregnancy causes significant morphological and functional changes in the woman's organism, including shifts in biomechanics of the spine and pelvis [5]. Though physiological adaptation occurs in all systems of the organism, the musculoskeletal apparatus is especially exposed to changes [6]. This is because the

center of gravity in pregnant women shifts forward, increasing the pelvis's bend in case of enhanced lordosis and pain in muscles of the back and legs. At the same time, limitations in movement of pelvic joints with a typical changes in gait in form of its instability and short steps [2, 5, 7].

Deep neck and back muscles, the main function of which are movements of the spine and head, are involved in the gravid adaptation of the musculoskeletal apparatus. Deep flexors of the neck include the longus capitis muscles, deep flexors of the neck and back – splenius cervicis muscles, as well as the muscle that straightens the spine. The latter muscle, located in the upper division of the lumbar region, is divided into 3 muscles: the iliocostalis, longissimus and the spinalis. In these muscles, regional parts are allocated (lumbar, thoracic, neck or head parts) [8]. It is known that they support a formation of correct posture and movement of the trunk and help strengthen the uterosacral ligaments. Among pregnant women, functional capabilities of these muscles are reducing [9].

Benefits of therapeutic exercises for a pregnant woman are high. The earlier she begins engaging in therapeutic exercises, the better she will be prepared for child delivery. Physical activity of pregnant women should be based on a principle of graduality, compliance to this principle in terms of sessions' duration, a number of repeated movements etc. However, it is recommended to refrain from a number of following types of motor activity: any games and activities with a high risk of falling, exercises accompanied by sudden movements, intense jumps, changing body position, performing exercises in a stuffy room or in a heat [10]. The most effective form of therapeutic exercises for the prenatal preparation of women and the intrauterine protection of the fetus are aerobics and water aerobics for pregnant women [11-12].

Therefore, the purpose of this study was to examine an effect of aerobic loads on strength indicators of deep neck and back muscles in women on a second trimester of pregnancy.

**Methods and organization.** The study included 207 women with an uncomplicated obstetric history and uncomplicated pregnancy. Sessions with aerobic loads for the prenatal preparation were carried out from the 16th to the 32th week of pregnancy. We chose special sets of exercises for sessions in a pool and sports gym. According to them, we formed three groups of pregnant women: the I group (n=100) engaged in water aerobics in a pool, the II group (n=57) – aerobics in a gym, the III group did not engage in systematic physical culture classes. Pregnant women visited 45-minute training sessions, recommended by a physician from a maternity welfare clinic, 3 times a week for 3 months. Content of training sessions for pregnant women and methodology of performing physical exercises in water were described in previous studies [12-13].

Table 1

## Overall description of water aerobics sessions in groups of pregnant women

| Before the beginning of sessions  | Duration of main parts      |                     |  |            | Music tempo       | Equipment                        |
|---|-----------------------------|---------------------|--|------------|-------------------|----------------------------------|
|   | Introductory part (aerobic) | Main part (aerobic) | Obligatory exercises (on the edge of the pool) | Final part |                   |                                  |
| <b>Beginner training group:</b><br>included basic exercises without modification and complicated coordination elements; exercises were performed in a slow tempo: 1-2 inhale, 3-4 exhale  |                             |                     |  |            |                   |                                  |
| -   | 10 min                      | 15 min              | -  | 5 min      | 120 beats/min     | Noodle                           |
| <b>Intermediate training group:</b><br>included modifications of exercises' performance and aerobic series, learned exercises were included in combinations, new exercises were added: 1-exhale, 2-inhale, with a reduced amplitude of performance and increased tempo  |                             |                     |  |            |                   |                                  |
| Contrast shower on extremities  | 10 min                      | 20 min              | 10 min   | 5-10 min   | 126-128 beats/min | Noodle, dumbbells                |
| <b>Advanced training group:</b><br>tempo of performing exercises and a duration of classes were increased, weights were gradually introduced, first on upper (gloves and dumbbells), then on lower extremities (boots); series of complicated coordination exercises with learned elements were performed; we used complicated exercises, which were not allowed to introduce earlier due to weakness and incoordination of the muscle system |                             |                     |  |            |                   |                                  |
| Contrast shower on extremities/ whole body  | 10 min                      | 30 min              | 10 min   | 5-10 min   | 134-136 beats/min | Noodle, dumbbells, gloves, boots |

Depending on the level of physical fitness of pregnant women, those who engaged in water aerobics were divided into 3 subgroups (table 1): beginner, intermediate and advanced. The first group included beginners, i.e. pregnant women who came to sessions for the first time. This group included women of different age, different process and gestational age, as well as different health condition and physical fitness. At the same time, their breathing pattern in aerobic mode was the same, they aligned their breathing with movements of their legs and arms. 1-3 weeks after regular sessions, they were transferred into the intermediate group due to the increased level of physical fitness, 3-6 weeks after – into the advanced group.

In order to evaluate an effect of aerobic loads on strength indicators of muscles we used following parameters: strength index (SI) of wrists as a ratio of the value of strength indicator when measuring dynamometry of the stronger hand (in kg) and body mass; special yoga exercises for testing deep neck and back muscles [14]; clinical system of five-point scale for evaluating the muscle system [15].

**Results and discussion.** Body mass at the beginning of the training classes during the second trimester (16 weeks) was  $59,3 \pm 1,4$  kg among women of the

I group (water aerobics) and amounted to  $65,1 \pm 0,7$  kg ( $p < 0,05$ ) by the 32th week of gestation. Increase of body mass by 9,8% ( $p < 0,05$ ) occurred evenly, the average of the group was by 400-500 g a week (table 2). Body mass of pregnant women who engage in aerobics increased in 12 weeks from  $58,9 \pm 1,7$  kg to  $64,2 \pm 0,9$  kg ( $p < 0,05$ ), or by 9,0% ( $p < 0,05$ ).

Table 2

Changes of anthropometric of pregnant women when conducting training classes

| Indicators                              | Groups of pregnant women |                     |
|---|--------------------------|---------------------|
|   | I group (water aerobics) | II group (aerobics) |
| Standing height, cm                     | $165,8 \pm 1,2$          | $166,4 \pm 1,2$     |
|   | $166,2 \pm 1,2$          | $167,1 \pm 4,2$     |
| Body mass, kg                           | $59,3 \pm 1,4^*$         | $58,9 \pm 1,7^*$    |
|   | $65,1 \pm 0,7$           | $64,2 \pm 0,9$      |
| Wrist strength of the stronger hand, kg | $27,6 \pm 0,9^*$         | $26,9 \pm 0,9^*$    |
|   | $32,6 \pm 0,6$           | $30,5 \pm 0,6$      |
| Strength index, %                       | $46,6 \pm 1,7^*$         | $45,8 \pm 0,9^*$    |
|   | $53,1 \pm 1,0$           | $51,1 \pm 1,1$      |

Note: numerator includes indicators of 16 weeks, denominator – 32 weeks; \* – level of differences' significance ( $p < 0,05$ )

It is known that among women during pregnancy, the tone of skeletal musculature is slightly reduced, which is indicated by a clinical evaluation of muscles for mainly 4 points, which corresponds to a small decrease in muscle strength when moving and overcoming resistance [15]. The progressing lumbar lordosis due to uterus expanding moves the center of gravity on lower extremities, and thus changes gate (“strut” of a pregnant woman) [7]. That is the reason why normalizing the tone of deep muscles of the neck and back with physical exercises is one of the main tasks of aerobic loads in case of the prenatal training of pregnant women.

To identify a degree of functional weakness, we tested deep flexors of the neck and deep extensors of the neck and back [14]. Women performed exercises lying on the stomach with a special massage couch for pregnant women on 16, 24 and 32 weeks under control of the instructor.

For deep neck flexors (the longus colli and longus capitis muscles), we conducted a test in a supine position with spread out legs along the body. For pregnant women who are not comfortable in this position or they cannot lie down horizontally due to the postural hypotonic syndrome, we offered a pillow to put between thighs. The raised head was fixated, the arms were straightened out along the trunk. Naturally, a duration of holding the head in this position is 30-35 s [14]. In case of 16 weeks, the duration of holding the head in all groups was practically the same (15,6-18,0 s), which indicated weak deep neck flexors in pregnant women. However, in the I and II groups, with the increase in a number of training sessions,

the duration was increasing. At the gestational age of 24 weeks, the duration holding the head in the I group amounted to  $29,4\pm 6,3$  s ( $p>0,05$ ), in the II group –  $27,1\pm 6,3$  s ( $p>0,05$ ). At the gestational age of 32 weeks, the duration of test performance was  $57,0\pm 6,7$  s ( $p<0,05$ ) and  $51,5\pm 9,2$ s ( $p<0,05$ ) respectively. Results of the test were better for women who engaged in water aerobics compared to women engaged in aerobics. Among pregnant women of the III group who did not engage in physical culture weakness of deep neck flexors remained (table 3).

Table 3

Testing (in seconds) of the spine muscles when carrying out water aerobics classes for pregnant women on different gestation terms

| Muscles   | Group | Gestational age |                   |                   |
|---|-------|-----------------|-------------------|-------------------|
|   |       | 16 weeks        | 24 weeks          | 32 weeks          |
| Deep neck flexors (longus colli and longus capitis muscles) | I     | $18,0\pm 6,3$   | $29,4\pm 6,3$     | $57,0\pm 6,7^*$   |
|   | II    | $15,6\pm 5,2$   | $27,1\pm 6,5$     | $51,5\pm 9,2^*$   |
|   | III   | $17,0\pm 6,2$   | $15,1\pm 7,1$     | $18,0\pm 8,0$     |
| Neck region of the muscle that straightens the spine        | I     | $18,9\pm 8,3$   | $69,5\pm 13,3^*$  | $126,6\pm 10,2^*$ |
|   | II    | $20,1\pm 9,1$   | $63,6\pm 13,8^*$  | $116,6\pm 9,7^*$  |
|   | III   | $19,0\pm 8,2$   | $25,1\pm 9,1$     | $18,0\pm 10,3$    |
| Thoracic region of the muscle that straightens the spine    | I     | $23,7\pm 9,8$   | $165,9\pm 13,2^*$ | $286,1\pm 14,2^*$ |
|   | II    | $17,0\pm 7,3$   | $130,0\pm 8,2^*$  | $181,5\pm 13,8^*$ |
|   | III   | $24,3\pm 8,7$   | $16,0\pm 9,8$     | $20,9\pm 7,9$     |
| Lumbar region of the muscle that straightens the spine      | I     | $19,3\pm 7,1$   | $86,0\pm 17,4^*$  | $158,7\pm 19,5^*$ |
|   | II    | $21,3\pm 9,3$   | $63,8\pm 8,1^*$   | $84,1\pm 16,1^*$  |
|   | III   | $18,3\pm 8,7$   | $19,0\pm 7,9$     | $19,7\pm 9,2$     |

Note: \* – level of differences' significance ( $p<0,05$ )

When performing a test for the neck region of the muscle that straightens the spine in a position of lying on the stomach, arms of a pregnant woman were located along the trunk, her head was raised and fixated. She did not bend her neck, but looked down. Naturally, a duration of holding the head in this position is also 30-35 s [14]. When testing, we obtained the same results as when testing neck flexors. Although, it is needed to note that the duration of holding the head in the I and II group was significantly higher (table 3). At the gestational age of 24 weeks, it amounted to  $69,5\pm 13,3$  s ( $p<0,05$ ) and  $69,5\pm 13,3$  s ( $p<0,05$ ); at the gestational age of 32 weeks –  $126,6\pm 10,2$  s ( $p<0,05$ ) и  $116,6\pm 9,7$  s ( $p<0,05$ ) respectively. Results of women who engaged in water aerobics were also better, weakness of the upper region of the spine flexor remained in pregnant women of the III group.

Testing of the thoracic region of the muscle that straightens the spine was also performed in a position of lying on the stomach, using the special massage couch for pregnant women. The legs were straightened, arch of the feet was pressed to the couch, arms were held under shoulders, and the thoracic region was raised from the couch and fixated. Naturally, a duration of holding the thoracic region in this position is 30-35 s as well. When testing this muscle, we obtained the same results

compared to other muscles. In addition, the duration of holding the thoracic region in the I and II groups was significantly higher (table 3). At the gestational age of 24 weeks, it reached  $165,9 \pm 13,2$  s ( $p < 0,05$ ) and  $130,0 \pm 8,2$  s ( $p < 0,05$ ); at the gestational age of 32 weeks –  $286,1 \pm 14$  s ( $p < 0,05$ ) и  $181,5 \pm 13,8$  s ( $p < 0,05$ ) respectively. Results of the test for women of the I group were better as well. Functional insufficiency preserved in women of the III group.

Testing of the lumbar region of the muscle that straightens the spine was also performed in a position of lying on the stomach, using the special massage couch. Legs were raised from the couch and fixated, hands were straightened along the trunk. A duration of holding legs in this position amounted to 30-35 s [14]. Testing of this muscle gave the same results. A duration of holding the legs in the I and II groups (table 3) was amounted to –  $86,0 \pm 17,4$  s ( $p < 0,05$ ) and  $63,8 \pm 8,1$  s ( $p < 0,05$ ) at the gestational age of 24 weeks; at the gestational age of 32 weeks – to  $158,7 \pm 19,5$  s ( $p < 0,05$ ) and  $84,1 \pm 16,1$  s ( $p < 0,05$ ). Better results were also found in the I group of women. Weakness of the thoracic region of the muscle that straightens the spine also preserved in women of the II group.

Thus, aerobic loads in case of the prenatal training of pregnant women made a favorable effect on strength indicators of the muscle system, including deep neck and back muscles. It is also important to note that it is shown in training sessions of pregnant women, both of aerobics and water aerobics. However, in case of water aerobics, improvement in strength indicators is more pronounced.

### **Conclusion.**

1. Normalizing tone of the muscle system with physical exercises is one of the main tasks of the prenatal training of pregnant women.

2. Shift of the center of gravity on the lower extremities with a development of the progressing lumbar lordosis is due to not only uterus expanding but also substantially weak deep back muscles in pregnant women because of gravid reduction of the tone of skeletal muscles.

3. Testing of deep neck and back muscles in different periods of pregnancy indicates their significant strengthening under the influence of aerobic loads.

4. Training classes of water aerobics are more preferable for the prenatal preparation of pregnant women.

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**Information about the authors:** **Anna Sergeevna Batrak** – Director of the Sports and Health-Improving Center “Grow Together”, Sochi, e-mail: 89885041111@mail.ru; **Elena Yur’evna D’yakova** – Doctor of Medical Sciences, Professor of the Department of Sports and Health-improving Tourism, Sports Physiology and Medicine of the National Tomsk State University, Tomsk, e-mail: adyakova@yandex.ru; **Leonid Sergeevich Khodasevich** – Doctor of Medical Sciences, Professor, Deputy of the Head of the Scientific Research Center of Balneology and Rehabilitation – Branch of the FSBI “North-Caucasian Federal Research-Clinical Center of Federal Medical and Biological Agency”, Sochi, Professor of the Department of Medical Rehabilitation of the FSBEI of HE “Kuban State Medical University” of the Ministry of Health of the Russian Federation, Krasnodar, e-mail: nic\_kir@mail.ru.