

Functional Mechanisms for Maintaining Posture in Humans during Ontogenesis

Svetlana Yuryevna Zavalishina*, Vladimir Yurevich Karpov, Anastasia Yuryevna Zagorodnikova, Alexey Alexeyevich Ryazantsev, Rustam Rashitovich Alikhojin, Natalya Nikolaevna Voronova

Received: 12 December 2020 / Received in revised form: 12 March 2021, Accepted: 19 March 2021, Published online: 23 March 2021
© Biochemical Technology Society 2014-2021
© Sevas Educational Society 2008

Abstract

Posture, appearing in the usual pose of a man, is of great biological importance. Features of posture are associated with the state of the neuromuscular system, psychological features, elasticity of intervertebral discs, and functional properties of the spine and pelvis. It is a complex marker, allowing to estimate overall health. When it is normal, then the condition usually is not serious. Changing posture takes place throughout life. The basis of the appearance of posture disorders can be long-term, not physiological postures when the musculoskeletal system is experiencing a strong load. Challenging posture in both planes negatively affects health. The appearance of posture disorders associated with changing the physiological bends of the spine, worsen the state of health. The curvature of the spine is called scoliosis. It is a severe progressive disease of the spine that occurs quite often and is a lateral bending and twisting of the vertebrae around a vertical axis. Changes in the spine on the background of aging often strongly violate posture. Older people gradually form rounded back and increased cervical and lumbar lordosis, which significantly violates the general health of the person and reduces the forthcoming life expectancy.

Keywords: Posture, Physiology, Ontogeny, Spine, Scoliosis

Introduction

Posture is a familiar pose of a person (Aly *et al.*, 2019; Ibrahim *et al.*, 2019; Karpov *et al.*, 2020; Makhov & Medvedev, 2020a; Mal *et al.*, 2020). Normal posture is characterized by the vertical

Svetlana Yuryevna Zavalishina*, Vladimir Yurevich Karpov, Anastasia Yuryevna Zagorodnikova
Russian State Social University, 129226, Moscow, Russia.

Alexey Alexeyevich Ryazantsev
Astrakhan State Medical University, 414000, Astrakhan, Russia.

Rustam Rashitovich Alikhojin
Russian University of Transport, 127994, Moscow, Russia.

Natalya Nikolaevna Voronova
First Moscow State Medical University named after I.M. Sechenova, 119991, Moscow, Russia.

*E-mail: ilmedv1@yandex.ru

direction of trunk and head, straighten the hip joint and fully extended in the knee joints of the lower limbs, "deployed" chest, slightly retracted shoulders, tight to the chest blades and toned stomach (Glagoleva & Medvedev, 2020; Makhov & Medvedev, 2020a).

Features of posture are associated with the state of the neuromuscular system, psychological features, elasticity of intervertebral discs, and functional properties of the spine and pelvis (Krapivina & Kryazhev, 2020).

Normal posture is an important criterion for determining the state of health of the person (Medvedev, 2018e). Posture seriously determines the functioning of internal organs and body systems. It is formed against the background of growth processes and strongly depends on the functional status of the body (Makhov & Medvedev, 2018; Mal *et al.*, 2018; Skoryatina & Medvedev, 2019). An optimal posture is an indicator of the health of the organism (Mal *et al.*, 2018).

The basis of the appearance of posture disorders can be long-term, not physiological postures when the musculoskeletal system is experiencing a strong load (Medvedev, 2018a; Medvedev, 2018b).

Often posture is broken under the action of the displacement of the entire spine in different directions. Some of them are in early childhood, others – during training, in school, and others – in the period of employment, the fourth – in the elderly and associated with aging (Medvedev, 2018c; Medvedev, 2018d).

Objective: to examine functional aspects of the formation of posture in humans.

Materials and Methods

The material for this work was published articles in open access. The search for literary sources was conducted in the database of the scientific electronic library eLIBRARY.RU, in the science of scientific information Scopus, and the Scientific Information Base of Web Of Science. The study applied the following methods for obtaining information: induction and deduction, analysis, synthesis, and generalizations.

Results and Discussion



Posture is the location of the body in space. This construction is complex unconditioned reflexes — a motor stereotype. Motor stereotype builds the segments of the body a particular body design in varying degrees, suitable for maintaining the vertical position and movement (Medvedev *et al.*, 2004). In a vertical position, the body is located normally, forming conditions for maximum stability, despite the strength of attraction. The dynamics of the pose to prevent falling is called skeletal balance (Oshurkova & Medvedev, 2018a).

Muscles move the parts of the body in space. But the muscles should not and cannot be in a state of prolonged tension, so, the body tends to adopt a position that does not require tension of skeletal muscles. This condition is called muscle balance in a vertical posture. If successful, the alignment should not be a burden on ligaments, since it is not capable of long-term resistance (Oshurkova & Medvedev, 2018b). In this case, the bones must be supplied in accordance with their form. The load on them must be directed strictly along the "axis of strength". Otherwise, the bone under the influence of long-term and usual load will be forced to change its shape in accordance with the loading conditions (Solovyova *et al.*, 2020).

With the functional weakness of the musculoskeletal system in children in the conditions of an improper position of the body quickly comes the fatigue of the spine and disrupts it. Even prolonged sitting generates a number of features in the body, hindering the function of the cardiovascular system and the lungs, which play a role in the development of somatic pathology. In the process of seating, the body is experiencing a static load. This is due to the need for a long time to maintain a forced working posture. This burden increases dramatically in case of incorrect device furniture, mismatch of size growth, and other somatometric parameters. Conditions for the development of myopia with a further violation of posture (Tkacheva, 2020).

With a long working position in the sitting position, there is static stress of muscles of the neck, back, shoulder belt, congestive pelvis in the pelvic organs, violation of blood circulation, and respiration organs. With the increasing accuracy of the action and a decrease in the monotony of work, the spine rests (Tkacheva & Medvedev, 2020; Vorobyeva & Medvedev, 2020a).

The above complications can be avoided during sedentary work if the person changes the posture during work, takes breaks, performs preventive exercises that lead to a redistribution of muscular load and improvement of circulation, limits the monotony of work, and as a consequence, constrains fatigue (Vorobyeva & Medvedev, 2019).

The posture affects a number of environmental factors, often disturbing it. Disorders of the posture on scoliotic type occur when the axis is shifted laterally. The offset of the posture in the sagittal plane can be with an increase in physiological curvature and with their decrease. When reinforced, a posture appears with a round-covered back. When concluding the severity of the curves, a flattened posture is registered. Complex disorders of posture are caused by

changing existing bends with the development of the side curvature of the spine (Vorobyeva & Medvedev, 2020b).

In the case of lateral shifts, scoliosis arises associated with the spinal curvature in the side and its twist. The curvature form is possible with a C-shaped version and S-shaped option. There are also less pronounced compensatory curvations (Bespalov *et al.*, 2018b).

In an aging person, there are anatomical, physiological, and biomechanical changes in the musculoskeletal apparatus (Vorobyeva & Medvedev, 2019). When aging, curvature in the cervical and lumbar portion of the spine is often amplified. With increasing kyphosis of the spine, the rounded back is gradually formed, with increased cervical and lumbar lordosis. For this reason, different types of posture can occur with age. The aging people are expressed by the bends of the spinal column in the head-rear (Vorobyeva & Medvedev, 2018).

With increasing age, the number of people with the same posture decreases sharply, and the number of cases with kyphosis posture increases (Vorobyeva & Medvedev, 2019). Often, in aging people, there is a displacement of the vertebrae or their incension in the spine post (Vorobyeva & Medvedev, 2020c).

Torsion curvature of the thorax and lumbar spine is present in more than half of practically healthy people of both genders, which is more noticeable with age. In many people, with torsion of the spine, its lateral curvature occurs (Makhov & Medvedev, 2018). Torsion and the weakening of the longissimus muscle develop on the background of dystrophic-destructive processes of the spine, enhancing the negative effect on the statics and dynamics of human aging (Vasilieva, 1996).

Relaxation of the abdominal muscles leads to an increase in all the curves of the spine. As a result, the head is displaced anteriorly. The pelvis is experiencing roll forward, changing its position regarding the spine (Kashuba, 2003).

The pelvic girdle acts as the bridge between the spine and the lower limbs and important to ensure that posture. The correct position of the pelvis depends on many factors, one of which is the harmonious development of those muscle groups that are attached to it. The first group includes the abdominal muscles and the muscles located on the back surface of the pelvis and hips. Second – the muscles are located on the anterior surface of the pelvis and hips (Bespalov *et al.*, 2018a).

The state of the spinal bends in the number is highly dependent on the angle of the pelvis. In the case of its increase, the spine increases its bends. In the event of a decrease in the tilt of the pelvis, the bends of the spine are flattened.

Conclusion

Posture is an ordinary person's pose. By the state of posture, a person's health is judged. Posture can change throughout life.

Posture can be impaired due to any changes in the physiological curves of the spine. Changes in posture due to lateral curvature is called scoliosis, which may lead to the pathology of the internal organs. Age-related changes in the spine form kyphosis with the appearance of a round back and increased cervical and lumbar lordosis, which significantly violates the general health of the person.

Acknowledgment: The authors would like to thank their colleagues for their contribution and support to the research. They are also thankful to all the reviewers who gave their valuable inputs to the manuscript and helped in completing the paper.

Conflict of interest: None

Financial support: The study was conducted at the expense of the authors.

Ethics statement: The study was approved by the local ethics committee of the Russian State Social University on September 15, 2018 (protocol №11).

References

- Aly, M. I. E., Amin, F. S., Negm, M. A., Attyah, A., & Diab, M. (2019). Effect of integrated exercise program on posture in Idiopathic Scoliosis. *Journal of Advanced Pharmacy Education & Research/ Jul-Sep, 9(3)*, 155-158.
- Bespalov, D. V., Medvedev, I. N., Mal, G. S., & Makurina, O. N. (2018b). Functional activity of the vascular endothelium in patients with initial signs of atherosclerosis against the background of regularly dose-related exercise stress. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(2)*, 1020-1024.
- Bespalov, D. V., Medvedev, I. N., Mal, G. S., & Polyakova, O. V. (2018a). Physiological capabilities of the vascular endothelium with the developing arterial hypertension in people of different ages who had long had low physical activity. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(2)*, 972-976.
- Glagoleva, T. I., & Medvedev, I. N. (2020). Physiological features of aggregation of the main formed elements of blood in calves at the beginning of early ontogenesis 00161. Published online: 28 February 2020. doi:10.1051/bioconf/20201700161
- Ibrahim, S., Azhar, A. S., Ather, A. S., Ahsan, A. S., Muneer, A. S., & Kaleem, A. S. (2019). Backache: association with stature, posture and work-station ergonomics in information technology professionals-an analytical study. *International Journal of Pharmaceutical Research & Allied Sciences, 8(2)*, 10-14.
- Karpov, V. Yu., Medvedev, I. N., Dorontsev, A.V., Svetlichkina, A. A., & Boldov, A. S. (2020). The state of cardiac activity in Greco-Roman wrestlers on the background of different options for weight loss. *Bioscience Biotechnology Research Communications, 13(4)*, 1842-1846.
- Kashuba, V. A. (2003). Biomechanics of posture. Moscow: Olympic Literature Publishing House, 279.
- Krapivina, E. V., & Kryazhev, A. L. (2020). Physiological parameters of hemostasis in weakened newborn piglets and calves with gamavit injection 00163. Published online: 28 February 2020. doi:10.1051/bioconf/20201700163
- Makhov, A. S., & Medvedev, I. N. (2018). Physiological characteristics of physically exercising people in the Poststroke period. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 987-992.
- Makhov, A. S., & Medvedev, I. N. (2018). The problem of traumatic brain injury in humans. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 425-434.
- Makhov, A. S., & Medvedev, I. N. (2020a). Physiological and morphological peculiarities of children with Down's syndrome: A brief review. *Bali Medical Journal, 9(1)*, 51-54. doi:10.15562/bmj.v9i1.1099
- Mal, G. S., Kharitonov, E. L., Vorobyeva, N. V., Makhova, A. V., & Medvedev, I. N. (2018). Functional aspects of body resistance. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 60-65.
- Mal, G. S., Medvedev, I. N., & Makurina, O. N. (2020). The prevalence of extreme severity of autoaggression among residents of Russia. *Bioscience Biotechnology Research Communications, 13(4)*, 2125-2129.
- Mal, G. S., Vorobyeva, N. V., Makhova, A. V., Medvedev, I. N., & Fayzullina, I. I. (2018). Features of physical rehabilitation after myocardial infarction. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 280-285.
- Medvedev, I. N. (2018a). Functional features of platelets in candidates and masters of sports in the athletics of adolescence. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 1395-1400.
- Medvedev, I. N. (2018b). Functional parameters of platelets in young men practicing in the football section. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 1315-1320.
- Medvedev, I. N. (2018c). Functional properties of platelets in amateur tennis players aged 18-35 years. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 1370-1375.
- Medvedev, I. N. (2018d). Physical effect of feasible physical exertion on platelet activity in overweight young men. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 1137-1142.
- Medvedev, I. N. (2018e). Dynamics of functional parameters of platelet hemostasis in young people with hemodynamic and metabolic disorders on the background of regular physical activity. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 1217-1222.
- Medvedev, I. N., Gromnatskii, N. I., Golikov, B. M., Al'-Zuraiki, E. M., & Li, V. I. (2004). Effects of lisinopril on platelet aggregation in patients with arterial hypertension with metabolic syndrome. *Kardiologiya, 44(10)*, 57-59.
- Oshurkova, Ju. L., & Medvedev, I. N. (2018a). Functional features of platelets in newborn calves Ayrshire breed. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 9(6)*, 313-318.

- Oshurkova, Ju. L., & Medvedev, I. N. (2018b). Physiological indicators of platelets in Ayrshire calves during the dairy feeding phase. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 9(6), 171-176.
- Skoryatina, I. A., & Medvedev, I. N. (2019). Correction of aggregation level of basic regular blood elements in patients with hypertension and dyslipidemia receiving rosuvastatin and non-medicinal treatment. *Bali Medical Journal*, 8(1), 194-200.
- Solovyova, L. P., Kryazhev, A. L., Kalysh, T. V., & Zamuravkin, V. I. (2020). Physiological characteristics of hemostasis in piglets after long transport 00165. Published online: 28 February 2020. doi:10.1051/bioconf/20201700165
- Tkacheva, E. S. (2020). Disaggregated control of blood vessels over platelets in milk piglets 00166. Published online: 28 February 2020. doi:10.1051/bioconf/20201700166
- Tkacheva, E. S., & Medvedev, I. N. (2020). Functional features of vascular hemostasis in piglets of milk and vegetable nutrition. *IOP Conference Series: Earth and Environmental Science*. 421(2), 022041. doi:10.1088/1755-1315/421/2/022041
- Vasilieva, L. F. (1996). Visual diagnosis of violations of the statics and dynamics of the musculoskeletal system of a person. Ivanovo: MIC, 112.
- Vorobyeva, N. V., & Medvedev, I. N. (2018). Physiological features of platelet functioning in calves of Holstein breed during the newborn. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 9(6), 129-135.
- Vorobyeva, N. V., & Medvedev, I. N. (2019). Functional activity of platelets in new-born calves of black-marked breed. *Bulgarian Journal of Agricultural Science*, 25(3), 570-574.
- Vorobyeva, N. V., & Medvedev, I. N. (2020). Functional platelet activity in Dutch newborn calves. In *IOP Conference Series: Earth and Environmental Science*, 421(2), 022042. IOP Publishing. doi:10.1088/1755-1315/421/2/022042
- Vorobyeva, N. V., & Medvedev, I. N. (2020b). Functional platelet activity in Dutch newborn calves. *Bioscience Biotechnology Research Communications*, 13(1), 201-205. doi:10.21786/bbrc/13.1/35
- Vorobyeva, N. V., & Medvedev, I. N. (2020c). Platelet function activity in black-motley calves during the dairy phase. In *BIO Web of Conferences*. EDP Sciences. 17, p. 00167. Published online: 28 February 2020. doi:10.1051/bioconf/20201700167.