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EFFECT OF FORWARD HEAD POSTURE ON STATIC AND DYNAMIC BALANCE IN ADOLESCENTs:A REVIEW

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ABSTRACT

The equilibrium of the muscles and skeleton that prevents damage of the body's supporting components is known as good posture. Posture is a complicated competency dependent on the interaction of sensory-motor processes rather than just a static reflex response. The effects of postural changes on health are not only for adults but also children and adolescents. Forward Head Posture (FHP) causes cervical proprioception sensory input degradation, muscle imbalance, and misalignment of the spine. FHP is a frequent postural deformity that has become more prevalent due to the habit of using computers, TVs, phones, and bag packs repeatedly, which encourages the body to adopt poor posture. The resulting muscular imbalance can lead to muscle shortening and elongation and dysfunction of various bodily parts. Poor body alignment results in tension and shortening of the muscles, which makes it harder to perform adequate joint motions and may even cause discomfort. Posture is the result of these faulty alignments. Once formed in childhood, an FHP's habit can cause the alterations listed above, predispose the child to discomfort in their early adult years, and alter both static and dynamic balance. FHP modifies the body's COG, which results in mechanical changes linked to postural control. The body makes an effort to adjust to these changes by changing the systems that control balance. When the ability to maintain balance during activities is poor ,the chance of falling raises and eventually limits subject 's range of motion

Key Words: Posture, Proprioception , Forward head posture, Balance.

INTRODUCTION

Posture is the way that body's parts are positioned in relation to one another at a specific moment .Complex interactions between skeletal muscles, connective tissues, joints, and the central and peripheral neural systems determine posture .Human balance, motor control, and motion in relation to gravity all contribute to the complexity of these relationships and interactions between them. Everybody changes throughout time as a result of a little to severe injury to muscles, connective tissues, and neurological control processes, which can cause noticeable postural alterations. It considers one of the most important markers of a person's health is their posture **(Fathi *et al.,* 2017).**

Posture is a result of human behavior and the factors causing poor posture are features of daily behavior. An individual's posture conveys information about their personality, activity level, and overall well-being. **. (Ningthoujam *et al.,* 2014).**

Body posture envolves throughout childhood and adolescence, Harmonious arches characterize the geometry of sagittal curvatures in a normal spine, which allow both mobility and stability **(Czaprowski *et al.,* 2018).**

Genetic and environmental factors linked to a child's activity level and ingrained habits influence body posture. Body balance and stability are required for the appropriate development of body posture, **(Mills *et al.,* 2018)**.

A person's posture may be deemed abnormal during the crucial phases of postural development, which include sexual maturation. The development and exacerbation of postural deviations are more sensitive during sexual maturation since it is one of the most active periods of postural abnormalities **(Proszkowiec *et al.,* 2012).**

A body that is not in its natural position is defined as a poor posture .It is one of the issues pertaining to kids' and teens' physical development. The basic symptoms of poor posture include knee hyperextension, anterior pelvic tilt, forward head posture, postural kyphosis, and trunk lean. Since digital technology is developing so quickly, using intelligent electronic gadgets has become widespread in many nations and regions. On the other hand, extended usage of smart devices is linked to a higher risk of bad posture. An estimated 65% of kids and teenagers have bad posture. Headaches, lumbar pain, and soft tissue injury are among the functional and structural diseases that adolescents with bad posture are more likely to experience.Furthermore, the aforementioned issues in maturity may also result from bad posture throughout youth (**Maekawa *et al.,* 2021).**

one of today's most prevalent health issues is postural deformities. The proportion of individuals exhibiting non-standard body posture is rising .34–50% of children and adolescents are thought to have several levels of severity for postural abnormalities. The musculoskeletal system and the neurological system collaborate to keep the human body working properly. In order for the central nervous system to attain its maximum potential, it develops at its fastest rate during a child's early years and Teenage years**.**

Our central nervous system (CNS) controls postural control, which is the process by which it processes sensory data from various systems and generates sufficient muscular output to sustain an upright, controlled posture. The primary sensory systems engaged in balance and posture control are the somatosensory, vestibular, and visual systems. The body's complex network of sensory neurons and pathways, known as the somatosensory system, reacts to changes on the exterior or within. By communicating information about body a place to the brain, it helps maintain postural balance by enabling the brain to initiate the proper muscular reaction or movement. The sub occipital region contains a disproportionately large number of mechanoreceptors that locates in muscles spindle, which are in charge of transferring information to and from the central nervous system. impulses from mechanoreceptors that in the upper cervical region helps to synchronize and regulate vision, balance and mobility of the neck for efficient postural control (**Alcock *et al.*, 2018).**

Feedback reflexes, primarily originating from proprioceptors found in muscles, tendons, and joint capsules, continuously maintain the body's posture. Proprioceptors are responsible for transmitting information about muscle tone, flexibility, and the relative positions of the trunk and limbs to the central and peripheral neurological systems **(Nordin *et al.*, 2012).**

The term "proprioception" describes the knowledge of one's body. Neural control of movement depends on proprioceptive information processing. Proprioception loss adversely affects both the spatial and temporal elements of voluntary movements, as well as the reflexive control of balance **(Cappello *et al.*, 2015).**

The three main categories of proprioception are sense of movement, sense of tension (resistance), and sense of joint position. Sensation of resistance is the capacity to recognize the force produced in a joint. The ability to recognize and understand joint movement, including its direction, amplitude, speed, acceleration, and timing, is referred to as sense of movement . Joint position sense is an individual's capacity to perceive a particular joint angle and then actively or passively recreate the same joint angle after moving a limb. It is possible to consciously and intuitively recognize how all three modalities support the body's natural ability to regulate movement, balance, and joint stability. Walking and participating in sports activities require them in order to perform daily duties (**Riemann and Lephart, 2002**).

Once the central nervous system has received information from afferent receptors in peripheral tissues involving muscles, joints, and ligaments, the proprioceptive system helps to coordinate and stabilize joint position and movement patterns. Reduced capacity to coordinate vital defensive reflexes, joint movements, balance, and postural stability results from impaired proprioception, (**Alahmari *et al.*, 2017).**

Recently, there has been a lot of focus on proprioceptive function accuracy. Proprioception, which functions in a closed loop between the brain and peripheral mechanoreceptors present inside muscles and other connective soft tissues, is primarily responsible for maintaining joint stability in a dynamic condition, **(Ghamkhar *et al.*, 2018).**

Position sensing impairment disrupts the neuronal and muscular regulation of normal cervical joint function, potentially leading to the premature production of imbalanced force and joint injuries **(Reddy *et al.*, 2019).**

The use of computers and smartphones has expanded due to the information and communication technology's rapid development. A user's head and neck are typically inclined more forward when using a smartphone than when watching a conventional television display. As a result, phone users' head and neck position is irregular (**Kim *et al.,* 2019**). Round shoulders and forward head posture (FHP) are the most prevalent issues associated with using a smartphone **(Kang *et al.,* 2012**).

In the last 30 to 40 years, the digital revolution has led to a global shift in the lifestyles of children and adolescents, with an increased focus on digital gadgets and a more sedentary lifestyle. Furthermore, the COVID-19 epidemic has negatively impacted physical activity for a large number of people, as well as contributing to an rise in sedentary behavior and close usage of electronic devices. From youth to maturity, sedentary behavior rises. Concurrently, headache, neck, and low back pain are becoming more common, and these ailments are the main reasons why people miss work due to illness worldwide (**Karageorghis *et al.,* 2021).**

Children's neck posture may be greatly influenced by a variety of factors, comprising misplaced furniture in the home and classroom .Prolonged shoulder (PS) posture and other spinal postural deviations are among the most common postural abnormalities in individuals with FHP, according to epidemiological studies **(Kim *et al.,* 2016).**

According to **Mariana *et al.,* (2016)** Among schoolchildren, postural abnormalities are highly prevalent، including valgus knees (43.1%), forward head posture (FHP)(53.5%), shoulder elevation (74.3%), iliac crest elevation (51.7%), lumbar hyperlordosis (37.2%), and winged shoulder blades (66.3%) (**Mariana *et al*., 2016).**

The cervical spine's functions

Head support: The head's weight is supported by the cervical spine .The head's weight is held squarely above the center of gravity when one is in good posture. In the forward head posture (FHP), the head is held forward of the center of gravity. the cervical spine experiences a stress load equal to the head's weight times the number of inches the head is displaced forward.

Mobility: The spine is a dynamic structure that can move in many different ways, such as flexion, extension, lateral bending, and head rotation.

Protection and transmission: The spinal cord and nerve roots are housed inside the spinal column's protective frame work . Within the intervertebral foramina, nerve pairs escape. Nerve roots and the spinal cord are safe guarded when the spine is in its ideal configuration. Normal nerve transmission becomes impeded upon the loss of this ideal spinal structure **(Elkhateeb *et al.,* 2015).**

Forward Head Posture (FHP) is hyperextension of the upper cervical (C1-C2) and flexion of lower C-spine (C3-C7). This abnormal position is typically maintained in response to an incorrect posture, which has a profound anatomical and functional impact on various body parts (**Mylonas and Others, 2021).**

One of the most prevalent postural abnormalities seen, with varying degrees of severity, is forward head position (FHP). A head position that is overly anterior in relation to the shoulder is common in people with FHP. This postural deviation is linked to neck pain, vestibular deficits, impaired proprioception, aberrant muscle activation, and changed breathing patterns, according recent reviews on FHP (**Szczygiel *et al.,* 2020).**

A single body segment can have an effect throughout the myofascial chain.. This shift in craniocervical alignment causes tension in tendons, muscles, and joints, especially in the neck and head region. Additional effects could include headaches, neck pain, restricted neck range of motion, and body imbalances. Furthermore, sagittal body posture is linked to occlusal and craniocervical skeletal abnormalities, mouth breathing patterns, and temporomandibular disorders (TMD) **(Szczygieł *et al.,* 2020).**

A persistently aberrant head position changes muscular activation, which impacts proprioception and the body's stability (**Elżbieta *et al.,* 2020).**

Risk factors and Causes

Adolescent female gender, advanced age, having previously smoked, having a demanding job, and having insufficient professional or social support are risk factors linked to forward head posture .Occupational posture, prolonged forward or backward head leaning, slouched or relaxed sitting, and incorrect sitting posture when using a computer or screen are some of the etiologies. Gravity's effect: bad ergonomic alignment and slouching. other incorrect positions, such as the pelvic and lumbar spine. sleeping with your head held too high. prolonged periods of time spent with poor posture. lack of strength of back muscles (**Mahmoud *et al.,* 2019).** Increased BMI ,head height and neck length (**Fawzy *et al.,* 2014**). other risk factors such as body build, muscle performance ,mental state ,personality and culture **(Ruivo *et al.,* 2014)** increased back pack loading (**Cheung *et al.,* 2010).**Prolonged tablet and computer use with head forward and neck flexion posture reproduced the neck pain and decrease the balance control **(Cheng-Chieh *et al.,* 2020)**

Forward Head Path mechanics

The cervical spine exhibits hyperextension of the upper cervical vertebrae and flexion of the lower cervical vertebrae when the head is positioned forward (**Cheshomi *et al.,* 2018).** The body shifts its weight anteriorly in this circumstance. The relationship between the line of gravity and the foot rest level is altered by this movement (**Osoba *et al.,* 2019**). In reaction to the head and neck's misalignment, the cervical muscles that contain a high density of muscle spindles and are crucial in supplying deep neck sensory information go through a few adaptive changes. The intrinsic cervical spine flexors are longer and the cervical spine extensors are shorter as a result of these modifications .Because of the unsuitable position of the head, these muscle's functions are altered, which negatively impacts movement and balance control and increases the risk of falling **(Smith *et al.,* 2019).**

FHP causes mechanical deformity of the joints, vertebrae, and muscles engaged in postural control by shifting the body's center of gravity forward. The cervical vertebrae's deep neck flexor muscles are crucial for maintaining cervical spine stability and lowering cervical lordosis when the neck is moved. FHP is typified by an increase in surface neck flexion and a reduce in the deep neck flexor muscles on both sides. This thus decreases the neck's range of motion and raises the surface neck flexor muscles' bending torque. Proprioceptive sensory input is contributed by the cervical vertebrae. Postural control is significantly influenced by the cervical vertebrae's proprioceptive sensing, which provides information to correct misalignment. Furthermore, it responds to minute movements of the head by coordinating its actions with vestibular system sensing. Errors in the information acquired by the eyes and ears are caused by asymmetrical head and neck alignment. Over time, this impairs balance and raises the possibility of falling and suffering musculoskeletal injuries when engaging in activities **(Lee *et al.,* 2016).**

In addition to having a stronger relationship to the vestibular and visual systems and having more muscle spindles, the upper area also exhibits higher levels of reflex activity (**Treleaven *et al.,* 2011**). Due to an anterior shift in gravity that mostly affects the front direction of balance, people with forward head position demonstrated a lower capacity to balance. **(Darshana *et al.,* 2019)**

FHP may be linked to medial rotation of the scapulae and thoracic kyphosis as a compensatory mechanism (**Kuo *et al.,* 2009).** Therefore, it is not unexpected that there was a correlation between FHP and the restricted range of scapular protraction and upper cervical extension (**Talbot *et al.,* 2005).**

Balance is a term that refers to the ability of an subject to maintain their orientation and stability, and it is important for maintaining appropriate posture and conducting normal activities **(Cheng-Chieh,*et al.,* 2020).**

Balance is defined as maintaining the body's center of gravity on the support base. The vestibular, proprioceptive, and visual systems are just a few of the complex sensorimotor control systems that work together to allow movement. Depending on the activity and surroundings, different information processing and biomechanics are needed for balance management.

Balance control is a complicated process that involves responses and interactions from the vestibular, ocular, musculoskeletal, and somatosensory systems. According to this interaction , motions are planned and carried out appropriately as well as that people's centers of gravity remain stable whether they are moving or stationary.

Balance is the ability of body to maintain the center of pressure (CoP) in internally and externally induced disturbances of stability through the synchronization of sensorimotor systems. Balance regulation is the suitable response to shifts in the center of pressure caused by oscillations in the center of gravity, muscle contractions, or awareness of one's environment **(Błaszczyk *et al.,* 2020**).

Effective control of balance requires postural competency of the spine. Spinal postural competence is the balance between the trunk's muscular response and the external forces acting on the spine. This equilibrium is sensory regulated and keeps the spine in a stable, upright posture both statically and dynamically. The spine is necessary for proper posture and efficient balance management in both adults and children.

To maintain the balance, the ability to perceive the body using a range of sense organs is required. sensory input is provided by the visual system to support balance as well as a sense of position and direction in space. Using cutaneous receptors, muscle spindles, Golgi tendon organs, and joint receptors, the somatosensory system transmits sensory data. The vestibular system receives movement data pertaining to inertial forces and gravity as well as information about the head's position. The central nervous system receives information about the position of the body and uses it to send signals to the muscular system in order to keep the body balanced. By regulating posture with the help of impulses from the central nervous system, the muscular system keeps the human body balanced. Therefore, intricate synchronization of the sensory, neurological, and muscular systems as well as coordination with other physical elements necessitate keep and control of balance.

Four categories of balance exist, proactive balance is anticipating a predicted balance disturbance, reactive balance is compensating for an unforeseen balance disturbance, stable dynamic balance is maintaining a stable position while walking, and stable static balance (**Azevedo *et al.*, 2022).**

It is customary to assess balance in both static and dynamic conditions. The capacity to sustain a body's line of gravity a vertical line drawn from its center of mass with the least amount of postural sway is known as static balance. Dynamic balance is the capacity to shift the center of pressure (CoP) both within and between a base of support (BoS)**.**

Balance can be divided into two categories: dynamic and static. Maintaining the center of gravity's (COG) stability within the base of support with the least amount of muscle contraction is the aim of static balancing. Dynamic balancing is the ability to keep the COG within the base of support, a task requiring greater neuromuscular effort. (**Gribble *et al.*, 2007).**

Two types of balance control abilities are distinguished: dynamic balance control, which controls balance during motion, such as walking, and static balance control, which controls balance while in a stationary position. Because the conditions dictate how these two balance control abilities are utilized, there are variations in the patterns and methods of using the joints. (**Aoyama *et al.*, 2011).**

CONCLUSION

This review looks at how forward head posture affects static and dynamic balance during adolescence. Forward head posture has been shown in numerous studies to impact both static and dynamic balance, especially in individuals who use computers and smart phones. A number of musculoskeletal disorders, such as temporomandibular disorder, tension-type headaches, shoulder and neck pain, trigger points in the suboccipital muscles, decreased vital capacity, and dyskinesia at the cervical spine and shoulder complex, have been associated with forward head posture in addition to impairing balance. FHP also causes vestibular hypofunction, subacromial impingement syndrome, thoracic outlet syndrome, reduced cervical proprioception, and quicker Center of Gravity reaction times and movement.

As a result, it appears that fixing FHP could be crucial to controlling and avoiding these effects. FHP is linked to a decrease in proprioception. This finding suggests that a shift in muscle length brought on by FHP impacts reduces the perception of joint position. Additionally, proprioception deteriorates with increasing severity of FHP. Proprioception aids in the preservation of ideal body alignment by sending sensory data from the body to the neurological system. A change in the function of cervical muscles due to the unsuitable position of the head has bad affect on the movement and balance, which leads to balance disturbance and increase risk of falling.

Conflict of interest

There is no conflict of interest disclosed by the authors.

Compliance with Ethics Requirements

There are no research involving human or animal participants in this article.

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تاثير الرأس الامامي علي الاتزان الثابت والمتحرك

ريهام علي الخضري ، أسماء أسامة سيد

قسم العلاج الطبيعي للاطفال ،كلية العلاج الطبيعي ،جامعة القاهرة

وضع الجسم هو حالة من التوازن العضلي والهيكلي الذي يحمي الهياكل الداعمة للجسم ضد الاصابة او التشوه التدريجي . لايمكن اعتبار وضعية الجسم استجابة منعكسة ثابتة ولكن كفاءة معقدة تعتمد علي تفاعل العمليات الحسية والحركية . لا تقتصر اثار تغييرات وضعية الجسم علي البالغين فقط بل و علي الاطفال والمراهقيين.وضع الرأس الامامي هو خلل في الفقرات العنقية وتشوه نتاج عن الاستخدام المتكرر لاجهزة الكمبيوتر والتليفزيون والهواتف المحمولة والحقائب التي تجبر الجسم علي اظهار موقف سئ مع تقصير العضلات و استطالة الاخري وينتج عنه خلل في التناسق والتوازن العضلي و بدوره يؤدي الي خلل في أجزاء مختلفة من الجسم ،وهذه العلاقات الغير متناسقة تسبب في خلل في العضلات مما يجعل حركات

المفاصل أكثر صعوبة في تحقيقها وقد تسبب الالم ، وتهيئ الطفل للالم في مرحلة البلوغ المبكر ، وتوثر علي التوازن الثابت والمتحرك .

وبتغيير وضع الرأس وازاحتها للامام يحاول الجسم التكييف مع هذه التغييرات عن طريق تغييرات ميكانيكية للسيطرة علي وضعية الجسم وتؤدي التعديلات الميكانيكية الي تغيير آليات التحكم في التوازن مما يقلل من قدرة التوازن أثناء اداء الانشطة المختلفة ويزيد من خطر السقوط.