REVIEW ARTICLE

Biomechanical Impacts of Forward Head Posture on the Respiratory Function

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ABSTRACT

Introduction: Forward head posture (FHP) is a very common problem among the working population. Being one of the most subconscious function in humans, respiratory function utilizes both the diaphragm and external intercostal muscles for quiet breathing. However during labored breathing, many other muscles will be recruited, and mostly these muscles have attachments in the cervical, thoracic ribcage, and even lumbar vertebrae. By the nature of attachments of these muscles on the cervical vertebra and thoracic cage, it is then plausible that FHP would affect the respiratory function.

Methods: Thorough searches were done through international journals for the last ten years regarding the topic of FHP and its impacts to the respiratory biomechanics.

Discussion: Previous studies have reported how prolonged FHP will result in kyphotic posture, reducing the mobility of ribcage, and modifies all respiratory muscular attachments such as sternocleidomastoids, intercostals, and to a certain extent, the diaphragm. All these result in a restrictive lung disorder, signified by reducing spirometry values, such as Forced Vital Capacity, Sniff Nasal Inspiratory Pressure, and Peak Flow Rate.

Conclusion: Forward head posture disturb the respiratory biomechanics.

Keywords: *Forward Head Posture, Respiratory biomechanics, Respiratory Function*

ABSTRAK

Pendahuluan: Saat ini, *Forward Head Posture* (FHP) adalah masalah yang sangat umum ditemukan pada populasi pekerja. Namun disaat tubuh membutuhkan usaha pernapasan tambahan, maka akan terdapat lebih banyak otot yang harus direkrut. Kebanyakan dari otot tersebut memiliki perlekatan pada regio servikal, sangkar toraks, dan bahkan vertebra lumbaris. Dengan sifat perlekatan otot-otot ini pada vertebra servikal dan sangkar toraks, maka tidak dapat dipungkiri bahwa FHP akan memengaruhi fungsi pernapasan.

Metode: Penelusuran literatur dari berbagai jurnal internasional yang telah dipublikasikan dalam sepuluh tahun terakhir, mengenai topik FHP dan dampaknya pada biomekanika pernapasan.

Diskusi: Penelitian terdahulu telah menunjukkan bagaimana FHP akan menyebabkan postur kifosis, sehingga menurunkan mobilitas sangkar toraks, dan secara keseluruhan merubah pelekatan dari otot pernapasan, seperti sternocleidomastoid, interkostal, dan bahkan diafragma. Semua perubahan ini akan menyebabkan gangguan paru restriktif, yang terlihat dari menurunnya nilai spirometri, beberapa diantaranya adalah *Forced Vital Capacity, Sniff Nasal Inspiratory Pressure, dan Peak Flow Rate.*

Kesimpulan: *Forward Head Posture* mengganggu biomekanika fungsi pernapasan.

Kata Kunci: *Forward Head Posture,* Biomekanika pernapasan, Fungsi Respirasi

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INTRODUCTION

Human respiratory system mainly comprises of two lungs, which is separated by mediastinal structure in between. Alveolus is the functional unit of the lung, and approximately counts up to 300 million in an adult lung.[1] The alveoli when unrolled will provide a surface area of 85 m^2 for gas exchange with the capillaries surrounding it. In order to perform effective breathing, the lungs is supported by muscles of the respiratory system, which allows physiological inspiration in order to allow the entry of atmospheric air into the lungs, this process is well known as quiet breathing. It could be seen that elevation of the ribcage occurs during inspiration, expanding the whole thoracic cavity for lung expansion, and conversely during expiration, there will be lowering of the ribcage as a recoil motion of the quiet breathing process.[1]

In cases of labored breathing, recruitment of accessory respiratory muscles ensues.[1] As the scalene and sternocleidomastoids actively mobilizes the ribcage upwards and outwards during inspiration, the internal intercostal and abdominal muscles would reversely constricts the ribcage downwards and inwards to produce labored expiration. Utilization of these muscles will increase the energy required in performing the work of breathing, and thus would result to further fatigue.[1,2]

Forward head posture (FHP) is defined as an anterior deviation in the sagittal plane of the head. It is frequently observed in working individuals, being very exposed to computer in prolonged duration, or due to a chronic condition.[3,4] It was also reported that FHP prevalence of 17% are obeserved in the geriatric population.[5] Whereas among children with osteogenesis imperfecta, all subjects were found to have forward head and kyphosis of varying degree, despite the prolonged supine position.[6]

Henceforth it is well known that this simple deviation is sufficient to generate significant biomechanical impacts on the human body. Importantly noted that any change to the respiratory system would eventually lead to further systemic deterioration.[7,8] This review is then aimed to discuss how FHP could affect the breathing function, as this would assist physical medicine and rehabilitation specialists in carrying out a comprehensive management for chronic respiratory disorders.

DISCUSSION

Postural Changes in Forward Head Posture

It is well known that thoracic kyphosis is highly correlated with forward head posture (FHP), and this condition seems also to correlate with age.[9] However nowadays the younger generations were also prone to the coupling of FHP and kyphosis due to longer static time in computer or gadgets alike.[10] Hence it would then be safe to assume that the changes were not solely based on degenerative changes, rather than a biomechanical compensation towards the anterior shifting of the centre of gravity by the head.[11,12] Obviously these changes would also modify the length-tension relationship of various muscles attaching to the cervical area (as seen on Figure 1), which further would affect the muscles of the upper thoracal area, resulting in a complicated the postural condition known as upper-crossed syndrome.[2,10]

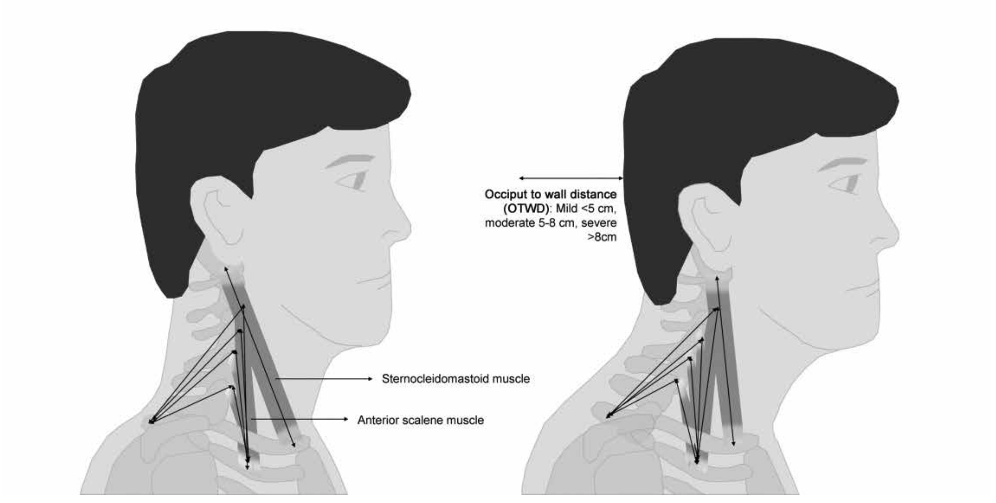

Figure 1. Normal Head Posture (Left), and Forward Head Posture (Right) with its relationship to the attachment of muscles

There are various ways to examine the severity of FHP. One of the simpler ways include the occiput-to-wall distance, which requires a rigid measuring tape measurement from the wall towards the occiput by taking the C7 bone prominence as a reference.[13] The method has been used as it was able to serve as a surrogate to the severity of the kyphotic deformity.[9,13] A simple description of the method requires the subject to stand with the head in their natural position, while their heels, sacrum and back touching the wall, and knees as extended as possible.[9] Additionally, the lower margin of the eye and upper margin of the acoustic meatus should be on the horizontal plane.[13] Balzini et al. had divided the severity of FHP into 3 categories based on their occiput-to-wall distance, mild (≤5.0 cm), moderate (5.1–8.0 cm), and severe (>8.0 cm).[9] Another method in measuring the severity could be done by using the C7 prominence to wall distance. The second method requires the usage of two rulers, one to be placed parallel to the C7 prominence and the other to quantify the perpendicular distance from the alignment of the first ruler to the wall.[14] By measuring C7 to wall distance, the cutoff value is 7.5 cm (Sensitivity 71.8%, Specificity 82.4%, AUC 0.85) to indicate hyperkyphosis.[14] This simple method has been used in other health conditions such as Parkinson disease, or presence of vertebral fractures, and is deemed reliable to be performed especially in health centers without sophisticated examining tools.[14,15]

Long duration computer working had been seen to be one of the main lifestyle causes of FHP. Studies have mentioned that sagittal head tilt would correlate to the presence of thoracal kyphosis, or the so called slouched posture.[12,16,17] These findings have revealed how the coupling would increase overall metabolic demands, and thus could result in slower gait speed, probably due to increased energy expenditure. This would be the case as thoracal kyphosis would jeopardize the postural control stability of the whole spine, and would exhibit its impact on increasing lumbar hyperlordosis, affecting recruitments of lower extremity muscles.[18] Another study had shown how FHP causes change in various muscle lengths for prolonged periods, and thus reduces proprioceptive sense along with worsening of FHP.[19] It is obvious that when muscle recruitment and proprioceptive sense is disturbed, a balance disorder could be expected, reducing overall mobility.[12,18,19]

Forward Head Posture and The Muscles Involved in Respiration

As shown in the previous section, the presence of FHP will greatly impact the cervical musculature, most of which, are involved in the process of labored breathing.[20] Furthermore, protrusion of cervical bones will then in turn cause adaptive changes in the thoracic vertebrae, which would simultaneously result in ribcage modification.[7] Finally all these changes would consequently affect the intercostal musculature, which also includes diaphragm in the lowest costal bones, resulting in a net result of both labored and quiet breathing alterations.[7,16] This section is then dedicated to discuss how each of the individual breathing muscles are affected by the faulty posture of forward head, and Figure 2 below will illustrate those particular muscles.

Inspiratory Muscles

External Intercostal Muscles is the primary muscles recruited during quiet breathing, there are 11 pairs of external intercostal muscles with parallel shapes, occupying the most superficial layer in between each intercostal spaces. The external intercostal muscles originates from the inferior border of the above ribs, and inserting towards the superior border of the ribs right below it. Each of these muscles are innervated with thoracic spinal nerves from T2 to T12 respectively. These muscles primarily function to elevate the ribs, and thus plays an important role during inspiration to expand the thoracic space.[1]

The upper thorax seem to shift significantly more forward in FHP during rest, compared to normal. Similarly the lower thorax will shift forward as well during FHP, and additionally more inward (retracted) at the midline border as compared to normal. These kinematic changes were quantified with the help of thoracic markers being recorded by a validated motion analyzer. The study also adds two more positions into the comparison, which is the maximal inspiratory and expiratory positions. In the maximum inspiratory position, where external intercostal muscles are recruited, the upper thorax will again be shifted more significantly forward in FHP, and the lower thorax is seen to be more restricted to expansion as compared to normal.[7]

Another study had added that FHP will reduce lower ribs motion in all three planes, and they had suggested the overuse of upper thorax in the discussed position, will in turn result in an ineffective lower ribcage expansion.[21] Recently it was also found that the conventional hypothetical recruitment of intercostal muscles by the 'size principle' of motoneuron recruitment was just a fundamental contribution towards the whole system. In response to that, the central nervous system was able to enable selective task-dependent recruitment, and these will call upon the most mechanically advantageous muscles to be primarily recruited.[22] Other than mechanical advantage, it was also shown that higher neural drive allows the recruitment of muscles with minimal metabolic cost of ventilation, and thus is the origin of local recruitment theory in the spinal network.[23]

Hence it could be drawn out that recruitment pattern of these intercostals vary towards the mechanical motion it is meant to perform.[22] Several reviews had attempted to show how surface electromyography (sEMG) could be utilized to show muscle activity in the intercostals area.[24–26] These sEMG findings revealed that intercostals generally becomes more active when breathing against resistance.[24] It was also found that only trace expiratory intercostal activity is recorded during 70% Maximum Voluntary Ventilation (MVV), which could indicate how during labored breathing there will be dominance of external intercostals to assist inspiration, and expiration recruits other muscles instead of intercostals.[26] This would be very plausible, knowing how both intercostal group muscles are similarly innervated.[1]

Whereas in the case of breathing with FHP, the ribcage is expected to be raised forward and outward, while the upper thorax is mechanically placed more forward, resulting in a higher activity of the upper intercostal muscles to effectively assist in ventilation.[7,20,23] Nonetheless, it should be remembered that lower ribcage motion is much lesser as compared the upper ribs, and thus FHP alteration in the upper ribs results in an overall reduction of ribcage motion, especially the lower ribs.[7]

The other inspiratory muscles is Diaphragm muscle, as a wide dome shaped muscle, which plays a very crucial role during inspiration phase of quiet breathing. It is innervated by the phrenic nerves arising from the nerve roots of C3 to C5.[27] It has a convex superior surface which forms the floor of thoracic cavity, and on the inferior side a concave surface forming the roof of abdominal cavity, making diaphragm an anatomical structure which borders the thoracic and abdominal cavity.[1]

The origin of the muscle lies on several sites of attachments, beginning from xiphoid process of the sternum on the anterior side as well as the costae rim, on the lateral side are the 6th up until 12th rib, and finally on the posterior side towards the 12th thoracic vertebrae.[1] It is important to know that the crucial role of diaphragmatic function lies in each of its muscular attachments. The diaphragm also has two appendages called crus, which is attached to the first three lumbal vertebrae.[1] Consecutively, these muscles then had a common insertion namely the central tendon, a strong aponeurosis which is located on the central area of the muscle, and later it fuses with the inferior surface of pericardium and pleurae. It is also known that on resting phase, the diaphragm builds up a dome shape, and oppositely during contraction, the diaphragm then flattens, expanding the thoracic cavity and increasing intra-abdominal pressure.[1]

Being primarily a cervical vertebrae disorder, FHP will disrupt the natural sagittal curves of the spine, thus adaptively modifying the thoracal vertebrae, these changes would then affect all the muscular attachments of the diaphragm.[1,7] Acknowledging the fact that diaphragm primarily attaches on the brim of lower ribcage, it could then be inferred that biomechanical changes will surely follow in the presence of FHP.[21] A recent analysis on ribcage had shown that the lower thorax will be positioned more inward in FHP during rest, more forward during maximum inspiratory phase, and more forward during maximum expiratory phase.[7] Another point of view was also brought into picture, that FHP and kyphosis could biomechanically cause temporary entrapment of phrenic nerves.[28] This then adds up to the inactivity of diaphragm due to lower number of fibers recruited for the contraction.[28] The summation of all these findings would reveal how the lower ribcage has lesser motion along the y axis, thus resulting in reduced anteroposterior diameter of lower thorax.[7]

Those pathomecanic decreasing diaphragm contraction by reduced excursion. Prolonged FHP conditioning may reduced diaphragm muscle strength.[7,28,29] Despite it would pose several challenges in quantifying the actions of diaphragm, many studies had shown how diaphragmatic strength would positively correlate to respiratory indices obtained from pulmonary function tests.[7] Generally, the weakness of inspiratory respiratory muscles will lead to restrictive pattern, the topic will be touched upon on the following chapter in this review.[27] Those investigations had successfully shown how FHP would disrupt the breathing mechanism, and eventually lead to deconditioning of diaphragm even in healthy individuals.[28,30–33]

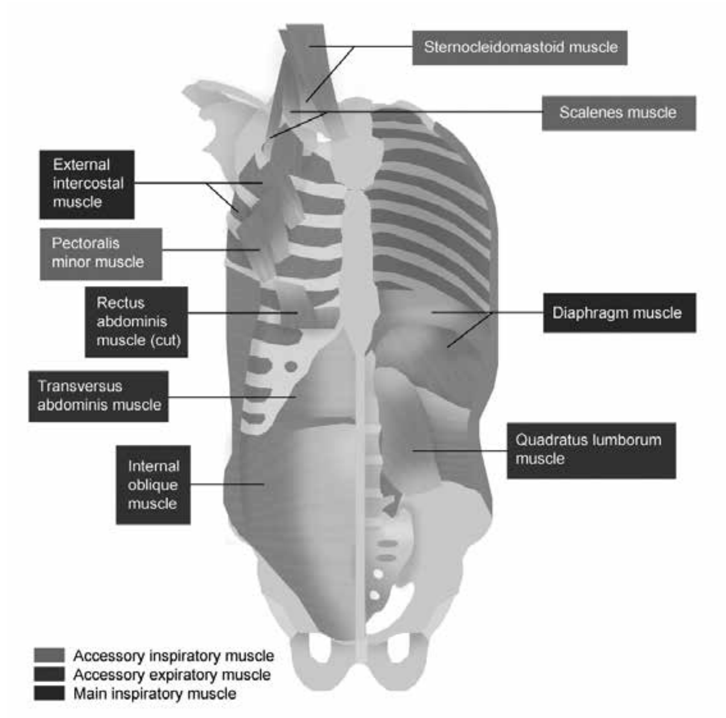

Figure 2. Inspiratory and Expiratory Muscles of Breathing in Human

Accessory Inspiratory Muscles

Sternocleidomastoid muscle is one of the large muscles in the cervical region, the muscles had major bones as its attachment, and due to this nature, it will eventually be recruited in the labored breathing process.[20] There are two heads of this muscle, the sternal head and clavicular head. Sternal head muscles originate from the manubrium of sternum, travels cranially towards the insertion in mastoid process of temporal bone and lateral half of the occipital bone.[1] The clavicular head, as the name implies, had the medial third of clavicle as its origin, and cranially attaching towards the same attachment as the sternal head.[1] These attachment will allow flexion of the neck in bilateral muscle contraction, as the muscle pulls the head by the atlanto-occipital joint towards anterior, while the clavicle and sternum remains in position. While in single unilateral muscle action of the sternocleidomastoid occur, then there will be lateral flexion and rotation of the head.[1]

Sternocleidomastoid muscle have a line of action in the atlanto occipital joint, certainly FHP would alter their biomechanics, stretching the muscles of its proximal and distal attachments.[1,30] One study had utilized a cadaveric computed tomography-based anatomic analysis, and measured FHP severity through occiput to T1 horizontal displacement, with a cutoff of 26 mm as FHP, and 40 mm as severe FHP.[20] That particular study had shown that sternocleidomastoid muscle is shortened by maximum of 5.4% with FHP.[20] Ultrasound study had also shown that the sternocleidomastoid will be thicker in FHP due to prolonged tonic contraction, practically this is the only cervical muscle group which was significantly different between control and FHP, accounting for 8.05 mm in control, and 8.7 mm for FHP.[34]

The sEMG studies on sternocleidomastoid had shown how their muscle activities really depend on the motions of upper costae, and are significantly more active in subjects with thoracal breathing, as compared to those with abdomino-thoracal breathing.[35] Henceforth, we know that the sternocleidomastoid is shortened due to prolonged tonic contractions in a pre-existing structural alignments of FHP.[20,34,36]

Scalene muscles are Secondary to sternocleidomastoid, the scalenes muscle also are considered the inspiratory muscles during labored breathing. As a group of three muscles, the scalene group are multipennate shaped muscle, placed in a spanning position beginning from C3 to C7, with a common distal attachment of the first rib for anterior and middle scalenes, and the second rib for posterior scalene. The anterior scalene originates from the transverse processes of C3-C6, and is the most anterior amongst the muscles in the group. Middle scalene are placed behind the anterior scalene, also is known as the longest and largest of the scalene group. Being the longest, the origin of the middle scalene is placed slightly further as compared to the anterior scalene, that is the transverse processes of C2 to C7. Lastly the posterior scalene is the smallest of the scalene muscles, spanning its proximal attachment only from the transverse processes of C4-C6, together attaching to the second rib.[1,21]

Anterior and middle scalene have same distal attachment, in labored inspiration, to elevate the first ribs during labored inhalation, while posterior scalenes elevate the second ribs during labored inhalation.[1] Cadaveric study reported that anterior scalene muscle will only be shortened by 3.2% in FHP, and posterior by only 0.4%, these numbers are significantly lower as compared to the shortening of sternocleidomastoids.[20] As mentioned before, a disturbance in upper ribs starting position will affect the motions of the lower ribs.[32] Therefore scalenes took its role in FHP by modifying the upper ribs motion, placing these origins in a more elevated, shortened position, disturbing the overall thoracic movements in labored breathing process.[32]

Pectoralis minor muscle is a triangular flat muscle which is located deep beneath the pectoralis major, and it is activated during labored inspiration.[1] This muscle originates variably from the second through fifth ribs, and attaches to the coracoid process of scapula. The medial pectoral nerves supply the pectoralis minor exclusively.[1] Its original course of action is to abduct scapula and rotate it downward, and in its opposite action, it would be able to lift the ribs upward during labored inspiration.[1]

There are still very few studies that discusses the recruitment of pectoralis minor muscle during respiration. However, it is still possible to show the activity of pectoralis during breathing, as one study had shown the placement of sEMG pad on the mid-clavicular line.[37] That particular study revealed that the recruitment of pectoralis minor muscles are significantly lower as compared to the other accessory inspiratory muscles as discussed above.[37]

With information on central nervous system respiratory modulation, it could be inferred that the pectoralis muscle activates the last, after the ribcage itself is lifted by external intercostals, upper trapezius and scalenes.[38] During the elevation of the ribs, they are placed more comfortably for the lifting action of pectoralis minor, preparing it in a better mechanical advantage.[1] It should then be remembered that this involuntary motion of ribcage is somewhat limited, and is more focused on creating suitable intrathoracic pressure, which may have been achieved by the recruitment of upper trapezius and scalenes.[39] Therefore in the presence of FHP, the sEMG activity of pectoralis minor may be in trace condition, most possibly due to the faulty coupling of FHP and kyphotic shoulder, and the protracted shoulder with drooping glenohumeral joint, will further place the pectoralis minor in a mechanical disadvantage for ribcage elevation, owing to its relations to shoulder joint.[1,40] Further investigations are required to see if this would be the plausible explanation.

Accessory Expiratory Muscles

Internal Intercostal Muscles is overlapped behind the external intercostal muscles. The eleven pairs of internal intercostal muscles draw adjacent ribs closer. Their action would then further reduce anteroposterior and lateral dimension of the thoracic cavity during labored expiration. Opposite to their counterpart, these muscles originate from the superior border of lower ribs, and attaches to the inferior border of the adjacent upper rib. Similarly, they are innervated by thoracic nerves of T2-T12 respectively.[1]

This alteration would then surely modify the length-tension relationship of the intercostal muscles, resulting in a further positioned ribs, and thus reduces the thoracic mobility.[7,25] Despite the expansion of the upper thorax in FHP, there is an overall reduced motion of ribcage during expiration, which would most probably caused by increased energy requirement in recruiting the accessory expiratory muscles to further bring down the ribcage.[7,16]

Several Studiy have proven the variability of intercostal muscles sEMG responses during inspiration and expiration.[24,26] It could be inferred that internal intercostals sEMG activity is mostly detected in expiration in 40% of MVV, and this activity reduces with the rise of MVV, reaching to trace activity in 70% MVV (full activity only on inspiration).[26]

The abdominal muscles are rectus abdominis, external oblique, internal oblique, and transverse abdominis muscles, are innervated by thoracic spinal nerves from T7-T12.[1] Beside, the iliohypogastric nerve, except for rectus abdominis, and ilioinguinal nerve for internal oblique and transverse abdominis muscles.[1] These muscles span from the lower ribs until the upper rim of the hip bone, and thus they function to flex the trunk, compressing the abdomen. Of important note is the transversus abdominis and internal oblique, which is located depeest among the layers, and acting together during respiration related modulation.[38]

Studies have shown how the abdominal muscles assist in breathing, especially during expiration.[41] Central nervous system function to modulate motor activities of the trunk muscles in performing both postural and respiratory function.[38] Voluntary postural control inputs are then incorporated with the rythmic impulses of diaphragmatic inspiratory motoneurons to regulate both intra-abdominal and intra-thoracic pressures.[39] Other studies have shown how these abdominal muscles may also assist inspiration despite their main role in expiration, as they may control the length tension properties of diaphragm.[42] This event would effectively limit diaphragm shortening to increase intra-abdominal pressure, coupled by diaphragm's flattening action, resulting in expansion of the lower thorax.[42] The interplay of pressures between abdominal and thoracic cavities are the keys to maintain the equilibrium of both postural control, and ventilatory exchange.[38,39]

During inspiration, despite trace activity, it was shown that only transverse abdominis and internal oblique that differ significantly in sEMG activation with or without respiratory load.[39] As rectus abdominis and external oblique is inactive during inspiration, this plausibility could be caused by their relaxation as diaphragm contracts, and lowering of intra-abdominal pressure is required to result in an increase of intra-thoracic space in inspiration.[39] These changes seem to persist even in the presence of respiratory load.[39] Oppositely, during expiration it was shown that there was an increase in sEMG activity, which reaches higher in the presence of inspiratory load, and highest when expiratory load was given.[39]

Among the muscles, transversus abdominis and internal oblique has the highest significant difference from without load as compared to the presence of expiratory load.[39] All these findings then revealed how abdominal muscles are activated during expiration, and increases in activity in the presence of respiratory load, in which FHP could induce by its restrictive nature to the ribcage.[7,16]

Quadratus Lumborum muscle is the the lowest positioned muscle in the respiratory modulation, quadratus lumborum is located in posterior thorax. It has its origin in iliac crest and iliolumbar ligament, and attaches cranially to the inferior border of rib 12 and L1-L4. The main innervation of this muscle lies in thoracic spinal nerve T12, as well as lumbar nerves L1-L4.[1] The muscle has several bellies and shaped rectangularly (thus is named quadratus), acting together to pull the twelfth ribs inferiorly, while acting singly they will laterally flex lumbar portion of the vertebra.[1] During labored expiration, quadratus lumborum helps to bring the ribs more inferiorly, while in labored inspiration, it will prevent the ribs elevation to expand the thoracic cage.[1]

There are few studies that discusses the significance of quadratus lumborum in respiration, and these studies utilize needle EMG seem to analyze both anterior and posterior portion of quadratus lumborum, despite sEMG could also be used.[42–44] The action of posterior quadratus lumborum seemed to be greater in inspiration with or without load, although it is actually attached to the vertebra instead of the twelfth ribs in the case of anterior quadratus lumborum.[42] It was then shown that both parts of quadratus lumborum are similar in activity with all directions of trunk loading, and thus would practically contract simultaneously.[42]

In the presence of FHP, which slightly translates the posterior ribs more forward, this would not cause many changes in the action course of the muscle.[7] With its position being on the axes of rotation of the lumbovertebral complex, slight alteration of the lumbar sagittal curve is expected to change the effective moment arms.[44] With the coupling of kyphosis in FHP on the accounts of body's adaptation to balance, it is common to see kyphosis is coupled with lumbar hyperlordosis.[45] It was also shown that EMG activity of quadratus lumborum increases only in this sitting hyperlordosis posture, as it would favor quadratus lumborum to lower ribcage after being initiated by diaphragm.[44] Continuous tonic contraction of anterior quadratus lumborum is then adequate to maintain the twelfth ribs in its position, which is done in order to create sufficient intrathoracic pressure for respiration, while consecutively maintains posture.[39]

Respiratory Function in Forward Head Posture
Ribcage configuration altered in FHP affected the function of respiratory. Decreasing of respiratory function can measured by spirometry. Decline of diaphragm contraction that mobilize the lower ribcage and stiffening the thoracic cage, may reduce vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow (PEF), and even sniff nasal inspiratory pressure (SNIP).[7,17,29,31,32]

There are few studies that focused on spirometric valus of FHP subjects have shown restrictive lung pattern pattern.[7,17,29,31,32] Slouched posture reduced 9.3% of SNIP, and reduced ribcage expansion in healthy individual. Other study have shown reduced of SNIP from 93.46 cm H_2O into 80.80 cm H_2O by the changing the posture during examination.[30] There was a negative correlation between spirometric values with the severity of FHP, which could be quantified by increased of craniovertebral angle.[17,29] Another study have shown the higher of FEV1/FVC in healthy individuals compared to the subject with neck pain. The studies have supported that FHP has correlation with restrictive lung disorder.[31] It is important to initially detect the presence of FHP to consider the potential bias in lung function test.[4,46]

Furthermore, the study on chronic obstructive pulmonary disorder (COPD) had revealed that FHP is really prevalent in this population.[4] The anatomical changes of respiratory muscles caused by COPD due to muscle wasting and malnutrition. Subjects with COPD have reduced shoulder flexion range of motion compared to controls.[4] The changes of the upper extremity structure as the adaptation to breathing pattern and increasing of metabolic demands in COPD. As the results were higher recruitement of accessory respiratory muscles. Pectoralis minor muscle length has strongest correlation with restrictive pulmonary function, and upper extremity mobility.[4]

CONCLUSION

Forward head posture FHP affected muscular function in the neck and thoracic area. The compesation of body posture by thoracic kyphosis and lumbar hyperlordosis coupling, may stiffened the ribcage and flattened the diaphragm. The pathomecanic of FHP cause the restrictive pulmonary disorder and detected by spirometry. In other hand, COPD can cause FHP that may initiate the restrictive pulmonary disease. The studies supported the correction of neck and trunk posture may increase the respiratory function.

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