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Influence of Protective Mask on Cervical Spine Dysfunction during COVID-19 Pandemic

Ramana K[1], Kumaresan A[2], Prathap Suganthirababu[2], Jagatheesan Alagesan[2]

[1]Assistant Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India; [2]Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

ABSTRACT

Introduction: World health organization recommends protective mask as a primary preventive measure to offbeat the Covid-19 pandemic. There are many commercially available protective masks, in that N-99, N-95, and 3 layer surgical masks are commonly used among peoples. Prolonged usage of this protective mask can cause forward neck posture and weakness of cervical flexors muscles.

Objective: The objective of this study is to find out the influence of the protective mask on cervical spine dysfunction.

Methods: An observational study was conducted by screening 237 participants; in that 110 participants were enrolled for the study based on the inclusion and exclusion criteria. All these participants were categorized based on the type of protective mask and underwent forward neck posture assessment by using the Cranio-vertebral angle through Kinovean software and cervical flexor muscle endurance test.

Results: The mean value of the Cranio-vertebral angle is 42.64 and cervical flexor endurance is 8.5 for the participants using N-99 protective mask, the mean value of the Cranio-vertebral angle is 65.866 and cervical flexor endurance is 19.911 for the participants using N-95 protective mask and the mean value of the Cranio-vertebral angle is 72.193 and cervical flexor endurance is 27.49 for the participants using 3- layer surgical mask.

Conclusion: The analyzed results prove that patients using N99 type of protective mask reported decreased cervical muscle endurance and Cranio-vertebral angle when compared to N95 and 3 layers protective mask.

Key Words: Cervical neck muscle endurance, COVID – 19, Cranio-vertebral angle, Protective mask

INTRODUCTION

Covid-19 is a new public health crisis threatening across the world which causes severe acute respiratory distress. It was reported that the virus originated in bats and was transmitted to humans. The Covid- 19 has impacted nations across the globe and health disaster is on the top of the disruptions caused. The estimation of the prevalence is 86% of the population worldwide. The prevalence of Covid-19 has no significant variation concerning gender and it is also found that children of all ages appeared susceptible to it.[1,2]

Covid-19 transmits through salivary droplets containing SARS Co-2 from the surrounding surfaces. World Health Organization (WHO) recognizes that there are direct and indirect modes of transmission of Covid-19 viruses. The direct transmission of the virus is through aerosols and indirect way of transmission is through contact with gadgets and furniture and those transmissions can be prevented by taking measures like wearing a protective mask, hand hygiene, social distancing and self-quarantine. The covid-19 virus has the potential to cause a respiratory infection; wearing the protective mask can shed the respiratory viruses when a person transmits them through aerosol.[3]

There are many types of protective mask available in controlling the spread of this aerosol borne infection. They are an N-type protective mask (N-95, N-99), a Surgical (3–layer) mask and a Dust mask (disposable mask). N-95 has been considered as effective face mask since it filters the virus around 0.06–0.14µm in diameter. N-95 protective mask is available with or without valve. Researchers suggest that the use of a Non-valve respirator mask is effective in preventing the transmission of aerosols through

Corresponding Author:
Dr. Kumaresan A, MPT (Neuro), PhD, D.Pharm, Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India. Contact: 7299934070; Email: kresh49@gmail.com

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exhaled air to the environment.[4] It is uncomfortable when the masks are worn for a longer period (more than 4 hours) as it is difficult to breathe. Prolonged wearing of a protective mask will increase the resistance of airflow, which in turn increases the work on sternocleidomastoid and scalene muscle.[5] Prolonged usage of a protective mask will cause fatigue and weakness of deep cervical flexors and increases the activity of the sternocleidomastoid muscle which can cause forward head posture, headache and dizziness.[6-8]

Many types of research have been discussed on the effect of usage of the protective mask with cardiovascular endurance along with respiratory muscle insufficiencies. No significant studies are highlighting the influence of protective mask on cervical spine dysfunction and pain. The purpose of this study is to analyze the influence of the different types of the protective mask on cervical spine dysfunction.

MATERIALS AND METHODS

An observational study with 237 participants was screened and out of which 110 participants met the selection criteria, both male and female with the age group between 20 to 50 years who use a protective mask more than 5 hours in the day for more than 45 days were selected. All the participants who showed willingness were explained and provided with an Information Sheet and Informed consent was obtained. The Ethical Clearance was approved by the Institutional Scientific Review Board, SIMATIC. 05/01/2021/ISRB/FR/SCPT. 110 participants have been allocated into three groups based on the type of mask they were using during the pandemic Covid-19. 14 participants with N-99 mask, 45 participants with N-95 mask and 51 participants with 3-layer surgical mask were allocated. All participants have undergone forward neck posture assessment and cervical deep and superficial flexor muscle endurance assessment. The forward neck posture assessment was performed in which the participant is instructed to stand straight without dropping their head down. The examiner stands by the side of the subject. The lateral view of the participant's head and neck has been captured by android mobile and it has been incorporated with the kinovean software application. The analysis of the craniovertebral angle has been made by intersecting an angle between the tragus of the ear with the C7 spinous process. The normal craniovertebral angle has been considered as more than 69 degrees. Less than 69 degrees was considered as forwarding head posture.[9] The cervical deep and superficial flexor muscle endurance assessment has been performed in supine lying over the examination couch. The participant's head has to be kept in a neutral position without keeping a pillow under the subject's head. The examiner then instructs the subject to tuck the chin in and lift off from the table up to 1 inch. The examiner will look for the substitution of platysma or sternocleidomastoid muscle for cervical postural maintenance which classically says the over activation of the sternocleidomastoid muscle. Less than 21 seconds has been considered as a lack of deep cervical muscle endurance.[10]

RESULTS

The number of samples collected was 110 of which 65.45% were male and 34.54% were female, where the average age of the group using mask N99 was 35.21, the average age of the group using the mask N95 was 33.711 and the average age group for the 3-layer surgical mask was 32.764. The average time of wearing the mask in the 3 groups was observed and recorded to be as 5.683 hours per day for an average of 45 days in each group. The mean value for the cervical spine endurance among subjects using N99, N95 and 3- layer mask was 8.5, 19.911 and 27.49 whilst the mean craniovertebral angle for the subjects using N99, N95 and 3-layer mask 42.64, 65.866 and 72.193 respectively. Based on the ANOVA-1, F- the calculated value of cervical muscle endurance is 91.85 and the F-tabulated value is 2.43, hence the calculated value is greater than the tabulated value (91.85>2.43). This shows N-99 protective mask can cause a high risk in cervical endurance when compared with the N-95 protective mask and 3 layers surgical mask. By using ANOVA-2, the F- the calculated value of the craniovertebral angle is 104.03 and the F-tabulated value is 2.43. Hence the calculated value is greater than the tabulated value (104.03>2.43). This shows N-99 protective mask can cause a reduced craniovertebral angle when compared to the N-95 protective mask and 3 layers surgical mask.

DISCUSSION

A profound number of patients complained to be having increased headache and cervical neck pain, during the pandemic covid-19 were reported in the clinical setup. During the assessment, it was found to be reduced cervical spine muscle endurance and abnormal Craniovertebral angle. The causative factor was found to be extended usage of mask per day over 2 months. This is supported with the study done by Elisheva et al., a cross-sectional study among health care professional with a sample size of 343 concluded in their study that long term usage of N95 mask showed adverse effect such as headache. The study conducted by Dae – Keun et al. showed that overactivity and fatigue of deep and superficial cervical neck flexors cause forward neck posture, which supports this study. Gwendolen et al. in their study concluded that prolonged eccentric activity of deep cervical flexors may have an impact on postural abnormality

Literatures showed that there was a correlation between the reduced neck muscle endurance and forward neck posture which could result in abnormal physiological loads on the

cervical spine in people with neck pain. The forward neck posture is anterior to an imaginary vertical line on a horizontal plane penetrating the body centre of mass such posture is largely associated with muscle length changes and weakness of deep and superficial cervical flexors, tightness of suboccipital muscle which causes cervical spine dysfunction as explained in the study done by Jeong and Schönhofer B et al. stated that resistive loading associated with breathing through a face mask increases work of inspiratory muscle such as sternocleidomastoid and scalene muscle which could cause fatigue which is more in the N99 type of protective mask.

This study also directs the clinicians to include the type of face mask and hours of usage, as a diagnostic factor in cervical spine dysfunction. The limitation of this study is observational and non-interventional. Future studies can be recommended between all types of with or without valve protective mask. With a larger sample size correlation between the variables in the groups can be reported. EMG analysis can be made as quantitative analysis for cervical spine dysfunction.

CONCLUSION

This study concludes that participants who were wearing N99 type of mask reported decreased cervical flexor muscle endurance and craniovertebral angle when compared to N95 and 3 layers surgical mask. Prolonged usage of the protective mask can be a threat for peoples who complaints of recurrent episodes of neck pain and headache. It is also essential for health care professionals to recommend the type of protective mask and also provide awareness on cervical postural correction and strengthening exercise protocol for peoples who are at high risk of getting cervical spine dysfunction.

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