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EFFECTS OF WEARING DIFFERENT MASKS ON CARDIOPULMONARY SYMPTOMS IN HEALTHY SUBJECTS

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ABSTRACT

Background: *Mask has been used to protect body from many kinds of microorganisms include Bacteria, Viruses, fungus that spread from air to air or person to person. Masks has been used worldwide specially in recent corona virus out-break to reduce the morbidity and mortality rate. Its use to protect from harmful particles but also has effects on out cardio-pulmonary symptoms when used all the time.* ***Aims and Objective:*** *This Study was conducted to see the effect of masks on cardio- pulmonary symptoms during submaximal functional activity.* ***Material and Methods:*** *Total 30 participants were recruited with informed consents. Different masks used such as KN95, Surgical, Cloth and no mask on subjects with 4 rounds of 6MWT for 24-48 hours so that findings of leg fatigue score cannot be affected due to previous activity. Inclusion criteria was age between 18–25 years and both male and female. Exclusion Criteria was history of cardio-pulmonary disease, participants who were unable to perform pulmonary function, walking test and age < 18 and > 25.* ***Results****: Results shows that wearing different types of masks had no remarkable effect on systolic blood pressure, diastolic blood pressure, pulse rate and oxygen saturation as value of p was more than 0.05. In contrast, significant consequences of wearing different types of masks were observed on dyspnea and leg fatigue score with p value 0.000 which was less than 0.05.* ***Conclusion:*** *This study concludes that wearing different kind of masks while performing sub-maximal physical activity produces noticeable effects on respiratory symptoms mainly dyspnea and fatigue amid the healthy individuals.*

Keyword*: Mask; 6MWT; Dyspnea; COVID-19; Exercise.*

INTRODUCTION

The usage of various masks has been widespread recently during corona virus with ongoing air pollution to safeguard people's health. Since the emergence of severe acute respiratory syndromes brought on by the CORONA virus or other reasons, facial masks are utilized all over the world. Nearly 452 million confirmed cases and nearly 6 million fatalities worldwide have been attributed to COVID-19 (1, 2). The

effects of COVID-19 are felt in numerous areas, including daily living. (For instance, increased a person's level of stress, interfered with usual social interactions, and burdened healthcare) Studies have shown that using a face mask while working out lowers cardiopulmonary physiological measures and raises respiratory symptoms. Studies found that exercising while wearing a mask impact on body systems, which raises risk of health issues. Exercise with a mask on may result in hypercapnic hypoxia, which intensifies cardiopulmonary symptoms (3). FFRs and surgical masks reduce SARS-CoV-2 viral transmission from person to person.3. By refocusing the emissions from exhaled breaths, aerosols spread more effectively around the head. If additional precautions like adopting an adequate distance are taken as well, such as this technique, exposures are reduced (6).

Current scientific research indicates that N95 FFRs filter out dust particles that is inhaled and exhaled, reducing the risk of illness for both the wearer and those close. Making a potential mask-wearing model. Revealed a significant decrease in peak hospitalizations and mortality, lowering the SARS-CoV-2 virus's effective transmission rate (7). In 2010, a review of face masks and influenza epidemics found enough potential benefits to support the use of face masks, even though the review found that masks were most effective when worn by people who were already experiencing symptoms (13). Following this, two other assessments examining the effectiveness of face masks against respiratory infections, including the flu, were published in pre-print in April and May 2020. These reviews made use of earlier research, such as randomized controlled trials. Both of these reviews came to the conclusion that using a face mask did not significantly reduce the risk of infection. Reviewing the scientific literature on other respiratory viruses has the drawback that COVID-19 is more contagious and has more severe effects (14). The effectiveness of face mask prevention specifically against COVID-19 is the subject of studies. Despite the virus' ability to linger in the air for a number of hours, one experiment using COVID-19 as an aerosol found that surgical face masks might serve as a barrier. In Hong Kong, a long-term study examined the impact of using face masks and other non- medical defense's against COVID-19. The result revealed a statistically significant advantage (15). Lockdowns sparked popular innovation, with several people creating their own washable cloth masks. A Stanford University study discovered that cotton masks are only 10 - 35% efficient at preventing aerosol particles the size of COVID-19 particles. When compared to surgical masks – often the blue one-use masks that are widely available – surgical masks were 95% effective at preventing aerosol particles from passing through (17). Polypropylene surgical masks are formed by melting at high temperatures. This structural design is more effective at particle absorption than woven fabric. The exterior blue or colored layer repels fluids, while the interior layer absorbs them. Stanford University discovered that these masks might retain their effectiveness even after being rinsed or washed 10 times (18). N95, KN95, and KF95 respirator masks are also available on the market. These can be found in a variety of sizes and designs, including a boat, cone, and cup, as well as versions for children. These customized masks are tighter than surgical masks and come with either internal or exterior nose clips that can be pinched into shape. All of these masks are made of overlapping polymer fibers with gaps as small as microns and may have a respirator attached to the outside layer (19). The number 95 on the masks implies that they should have a 95% filtration efficiency, typically against particles of 0.3m in size, though this varies depending on the brand. Although COVID-19 virus particles are thought to be 0.1m in size, they are spread by bigger aerosols. These larger vehicular particles mostly fall within the 4–8 m range. Beyond the droplet's evaporation, viral leftovers may cling to the air; the size of these infectious particles ranges from 0.5 m to 20 m (20). The NIOSH has authorized N95 mask in accordance with U.S. Centers for Disease Control (CDC) recommendations. Hospitals in the United States and Great Britain also employ hese masks, which are manufactured to ASTM F3502-21 standards. A CE label, which is visible on the box, is given to masks that are permitted for use in the EU (21). Chinese KN95 masks are an option that adheres to Chinese standard GB2626:2006. These are targeted by an overwhelming number of people despite being promoted as having the same filtration effectiveness as N95 masks (22). Wearing a mask continuously puts a lot of physical and mental strains and can lower productivity. When you have a mask on, you can't perform an activity as long or as well as you can when it's off. Utilizing PPE and masks also limits how long an activity can be continued.

Using surgical and N95 masks for an extended period of time can have harmful physical effects on the user's body, such as headaches, breathing issues, rashes, acne, skin disintegration, and cognitive impairment. Additionally, it has an impact on communication, eyesight, and thermal homeostasis (24). Headaches caused by prolonged mask use can be attributed to mechanical, hypercapnic, and hypoxemic factors. Tight straps, pressure on the cervical nerves, and pressure on the superficial face are mechanical causes of headaches. among addition to mental stress, lack of sleep, irregular mealtimes, and cervical neck pain from wearing PPE, wearing masks for an extended amount of time can also cause headaches among medical workers. Tight-fitting masks result in inadequate ventilation and hypercapnia, a condition. Due to the fact that CO2 is a known respiratory stimulant, an accumulation of exhaled CO2 between the mask and face will increase lung ventilation and respiratory activity (25).

Long-wearing masks can cause hypoxemia symptoms as tachypnea and chest discomfort in healthcare professionals. Exhaled CO2 builds up between the mask and the face, and excessive CO2 levels cause confusion, poor cognition, and disorientation (26). The area of the face covered by masks is hot and humid, which can lead to pain and hyperthermia. This may make it difficult for the healthcare worker to recognize threats and carry out physical duties, and it also has a substantial impact on motor abilities. Facial ducts are also blocked by the humid climate with pressure of tight masks. This explains why acne rates rise when mask use is continued (27). Tight-fitting masks and goggles that put pressure on the cheekbones and nose bridge can be blamed for skin breakdown in these areas. Altering PPE and masks frequently can also cause skin to shear and deteriorate (28). Sensitivity to PPE and mask components might result in urticaria and contact dermatitis. Some people are allergic to or sensitive to the chemical formaldehyde, which is used in PPE. Others might respond to the thiuram in surgical masks' ear loops (29).

Participants in the survey reported that taking frequent, short breaks, neck massages, increasing fluid intake, especially before a shift, alternating between surgical and N95 masks (if practical), wearing a N95 mask with a filter to improve ventilation, and donning the mask that best fits one's face are all effective ways to prevent headaches and cognitive impairment (30). Dyspnea, or shortness of breath, is the term used to describe the subjective sensation of having trouble breathing that is made up of a number of emotions of varying intensity. The primary symptom of a respiratory, cardiac, neuromuscular, psychogenic, or systemic illness, or a combination of these, it is regularly experienced by millions of individuals. Acute symptoms of dyspnea might continue for a few hours to a few days, but chronic symptoms can remain for more than four to eight weeks (32). Dyspnea is not the disease; rather, it is one of its symptoms. The four main types of its etiology include Pulmonary, cardio, neurology and musculoskeletal, psychotic, and system disease (33).

A few examples of cardiovascular causes are congestive heart failure, pulmonary edema, acute coronary syndrome, pericardial tamponade, valvular heart defect, pulmonary hypertension, cardiac arrhythmia, or intracardiac shunting. Examples of neuromuscular causes include chest trauma with a fracture or flail chest, excessive obesity, kyphoscoliosis, spinal cord dysfunction, paralysis of the phrenic nerve, myopathy, and neuropathy (34). Dyspnea is the inability to breathe deeply or rapidly enough and the associated sense of being out of breath. It is produced by the interaction of the mechanoreceptors of the upper airway, lungs, and chest wall with peripheral receptors, chemoreceptors, and other receptors (36). One of the field walking tests advised to assess the effectiveness of functional exercise is the six-minute walking test (6MWT). Its foundation is a typical daily activity. Through sub- maximal exercise, the 6 Minute Walk Test assesses aerobic capacity and endurance. The use of a mask might indicate that the channels for inspiration and expiration are blocked, which could be painful for many people. The discomfort and the pressure buildup encourage forceful, shallow breathing and increase the activity of the respiratory accessory muscles (37). Investigating the effects of using various masks on inspiratory airflow and oxygen saturation is the goal of this study.

METHODOLOGY

A prospective crossover study was conducted in the University of Faisalabad. Total 36 participants were included in this study via simple random sampling technique. Students of both genders were included with age ranges 18–25 years. Students who have History Cardio-pulmonary disease, Participants who were unable to perform

pulmonary function, walking test were excluded. Three different types of masks were used for collection of data.1 Surgical mask, 2. Cloth mask, 3. KN95 mask. This procedure duration was 24-48 hours. In round one, investigator asked the subject to perform 6MWT without any mask after relaxation period round two was performed. In round two participants were performed 6MWT with cloth mask then after relaxation period round 3 was performed. In round three subjects were asked to do 6MWT with surgical mask then after relaxation time round 4 was performed, in round four with KN95 respirator. Pulse rate, O2 saturation, and BP values were taken before and after each round. BP apparatus (sphygmomanometer), Oxygen Saturation (pulse oximeter), Pulse rate (pulse oximeter), The Borg Category-Ratio-10 scale, Leg Fatigue Score Scale were sued to collect data.

Surgical Mask KN-95 Mask Cloth Mask

RESULT

Descriptive statistics and Friedman test were used to find out the Effects of wearing different masks on respiratory symptoms / Oxygen saturation during 6MWT in healthy subject. Total 30 subjects were recruited. Out of 30 participants, 18 were male and 12 were female having male ratio (60%) higher than female ratio (40%) with mean age 21 years. systolic blood pressure of the participants with different masks. Median value of systolic BP without mask and surgical mask was 120.00±13.522 and 120.50±11.445 respectively. Median value of cloth mask and KN95 was 118.00±11.877 and 119.00±9.234 respectively. According to Friedman Test for Systolic and diastolic Blood Pressure there was no statistical difference between systolic and diastolic blood pressure of the participants wearing different masks as value of significance was more than 0.05.

Table 1: Systolic & Diastolic Blood Pressure 0f the Participants

N		Mean	Std. Deviation	50th (Median)
Systolic BP Without Mask	30	119.0333	13.52261	120.0000
Systolic BP Surgical Mask	30	120.6000	11.44582	120.5000
Systolic BP Cloth Mask	30	117.8667	11.87792	118.0000
Systolic BP KN95 Mask	30	118.8000	9.23412	119.0000
Diastolic BP Without Mask	30	78.5333	6.91193	78.5000
Diastolic BP Surgical Mask	30	79.9667	6.11659	80.0000
Diastolic BP Cloth Mask	30	78.6667	5.98465	79.5000
Diastolic BP Cloth Mask	30	77.1667	7.05194	78.0000

Effects of Wearing Different Masks on Pulse Rate Mean value of PR without mask and surgical mask was 85.000±10.623 and 85.000±9.679 respectively. Median value of cloth mask and KN95 was 81.000±8.931 and 82.000±9.663 respectively. Study results found that there were statistical difference between dyspnea and leg fatigue scale of the participants wearing different masks as value of significance was less than 0.05.

Table: 2 Effects of Wearing Different Mask

N	Mean	Std. Deviation	50th (Median)

Effects of Wearing Different Mask Pulse Rate				
.PR Without Mask	30	84.0333	10.62360	85.0000
PR Surgical Mask	30	85.6000	9.67970	85.0000
PR Cloth Mask	30	83.2333	8.93148	81.0000
PR KN95 Mask	30	82.8333	9.66359	82.0000
Effects of Wearing Different Masks on Oxygen Saturation				
SP02 Without Mask	30	98.5000	.93772	98.0000
SPO2 Surgical Mask	30	98.3000	.87691	98.0000
SPO2 Cloth Mask	30	98.2000	1.03057	98.0000
SPO2 KN95 Mask	30	98.3000	2.18380	99.0000
Effects of Wearing Different Masks on Dyspnea				
Dyspnea/10 Without Mask	30	.0333	.12685	.0000
Dyspnea/10 Surgical Mask	30	.5000	.45486	.5000
Dyspnea/10 Cloth Mask	30	1.2167	.84775	1.0000
Dyspnea/10 KN95 Mask	30	1.3000	.98786	1.0000
Leg Fatigue Score of The Participants				
LFT/10 Without Mask	30	.1167	.31303	.0000
LFT/10 Surgical Mask	30	.2667	.50401	.0000
LFT/10 Cloth Mask	30	.6333	.84009	.0000
LFT/10 KN95 Mask	30	.7000	.82629	.5000

DISCUSSION

This prospective cross-sectional study was delineated to evaluate how wearing different kind of masks can affect cardio-pulmonary symptoms among physically fit individuals. The study was conducted at The University of Faisalabad. 30 subjects were recruited to participate in the research. Three kinds of mask were used to collect the data from participants. The out-turn measure includes O2 saturation, BP & Pulse Rate. This procedure took quadruple rounds to complete. Participants performed 6 minutes' walk test wearing different masks in each round. Data was collected before and after performance of 6MWT. It took 24-48 hours to complete the plan.

Results of this study reveal that Oxygen saturation, heart rate, and systolic and diastolic pressure did not change much when different masks were worn. Value of p for these outcome measures was more than 0.05 which shows that there were no significant consequences. However, some significant effects of masks were observed on dyspnea and leg fatigue score. In accordance with the results value of p for dyspnea and fatigue was less than 0.05 showing statistically significant difference. Taking everything into account, this survey proved that wearing different masks specifically fabric mask and KN95 leads to negative impact on respiratory symptoms mainly dyspnea and fatigue. Evidence from the literature falls in support of the results of this trial.

Dacha, Chuatrakoon (46) carried out a research study to explore the impacts of put-on various kinds of masks on pulmonary indications, O2 saturation and practical capability while performing six minutes' activity (6MWT), which is kind of submaximal physical activity. 4 rounds of the plan were executed by twenty-nine people of age 22 years while wearing different masks during each round. Oxygen saturation and respiratory indications such as breathlessness, and difficulty of breathing were measured before and after each round. Outcome of this study indicates that wearing fabric masks and N95 masks could cause increased struggle to breath as compared to surgical masks or no masks. On the other hand, wearing these masks had no noticeable effects on blood pressure, heart rate or oxygen saturation while doing functional activity. Results of this present study also illustrates that wearing cloth masks and KN95 can adversely affect effort for breathing and enhances fatigue while performing physical activity in comparison with no masks or surgical masks. In contrast wearing different type of masks had no influence on blood pressure, heart rate or oxygen saturation of individuals.

To investigate the adverse out-turns of facial masks in daily life a review was conducted by Kisielinski, Giboni (40). Changes in physiology of respiration were noticed among masks users including linkage of oxygen drop and fatigue. Outcomes suggested that oxygen drop and respiratory impairments co-occurred (67%). Using N95 masks resulted in dyspnea and temperature rise (88%), headache (60%), rise of CO2 (82%) and rise in humidity beneath mask (100%). Current study also supports the fact that cloth masks and KN95 masks users were more vulnerable to suffer from respiratory impairments such as dyspnea, rise in breathing effort and fatigue.Shein, Whitticar investigated the influence of face masks on ventilation and oxygenation at rest and while performing physical task. Heart rate, carbon dioxide tension and level of oxygen were recorded at the end of six 10-minute phases. Results suggested that there was no effect of wearing masks on enhanced oxygen and carbon dioxide level at rest or doing any activity. In contrast current study reveals that wearing different types of masks could lead to worse effects on respiratory system including dyspnea and fatigue. The majority of the evidence from the past five years is related to this study's results. This demonstrates that wearing various types of masks while engaging in any physical activity may have a negative impact on a person's respiratory problems (42).

CONCLUSION

This study concludes that wearing various types of masks while performing sub-maximal physical activity produces noticeable effects on respiratory symptoms mainly dyspnea and fatigue amid the healthy individuals but there is no effects of mask on blood pressure and pulse rate.

RECOMMENDATION

More studies can be done on this problem with large sample size and assessment of preexisting conditions having impact on cardio-pulmonary symptoms. Healthy individuals should be recommended to check quality of masks and use the type of mask which has less impact on their cardio-pulmonary symptoms.

REFRENCES

Tirupathi R, Bharathidasan K, Palabindala V, Salim SA, Al-Tawfiq JA. Comprehensive review of mask utility and challenges during the COVID-19 pandemic. Infez Med. 2020;28(suppl 1):57-63.

Organization WH. Mask use in the context of COVID-19: interim guidance, 1 December 2020. World Health Organization; 2020.

Dacha S, Chuatrakoon B, Sornkaew K, Sutthakhun K, Weeranorapanich P. Impact of wearing different facial masks on respiratory symptoms, oxygen saturation, and functional capacity during six-minute walk test (6MWT) in healthy young adults. Eur Respiratory Soc; 2021.

Forouzandeh P, O'Dowd K, Pillai SC. Face masks and respirators in the fight against the COVID-19 pandemic: An overview of the standards and testing methods. Safety science. 2021;133:104995.

Xi J, Si XA, Nagarajan R. Effects of mask-wearing on the inhalability and deposition of airborne SARS-CoV-2 aerosols in human upper airway. Physics of Fluids. 2020;32(12):123312.

Morawska L, Milton DK. It is time to address airborne transmission of coronavirus disease 2019 (COVID-19). Clinical Infectious Diseases. 2020;71(9):2311-3.

Sommerstein R, Fux CA, Vuichard-Gysin D, Abbas M, Marschall J, Balmelli C, et al. Risk of SARS-CoV-2 transmission by aerosols, the rational use of masks, and protection of healthcare workers from COVID-19. Antimicrobial Resistance & Infection Control. 2020;9:1-8.

Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. The Lancet Respiratory Medicine. 2020;8(5):434-6.

Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ, et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. The lancet. 2020;395(10242):1973-87.

Willis LH, Slentz CA, Bateman LA, Shields AT, Piner LW, Bales CW, et al. Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. Journal of applied physiology. 2012.

Alberts SR, Sargent DJ, Nair S, Mahoney MR, Mooney M, Thibodeau SN, et al. Effect of oxaliplatin, fluorouracil, and leucovorin with or without cetuximab on survival among patients with resected stage III colon cancer: a randomized trial. Jama. 2012;307(13):1383-93.

MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. BMJ open. 2015;5(4):e006577.

Condon BJ, Sinha T. Who is that masked person: The use of face masks on Mexico City public transportation during the Influenza A (H1N1) outbreak. Health Policy. 2010;95(1):50-6.

Milton DK, Fabian MP, Cowling BJ, Grantham ML, McDevitt JJ. Influenza virus aerosols in human exhaled breath: particle size, culturability, and effect of surgical masks. PLoS pathogens. 2013;9(3):e1003205. Leung NH, Chu DK, Shiu EY, Chan K-H, McDevitt JJ, Hau BJ, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks. Nature medicine. 2020;26(5):676- 80.

Cheng VC-C, Wong S-C, Chuang VW-M, So SY-C, Chen JH-K, Sridhar S, et al. The role of community-wide wearing of face mask for control of coronavirus disease 2019 (COVID-19) epidemic due to SARS-CoV-2. Journal of Infection. 2020;81(1):107-14.

Hossain E, Bhadra S, Jain H, Das S, Bhattacharya A, Ghosh S, et al. Recharging and rejuvenation of decontaminated N95 masks. Physics of Fluids. 2020;32(9):093304.

Gralton J, McLaws M-L. Protecting healthcare workers from pandemic influenza: N95 or surgical masks? Critical care medicine. 2010;38(2):657-67.

Regli A, Sommerfield A, von Ungern-Sternberg B. The role of fit testing
N95/FFP2/FFP3 masks: a narrative review. Anaesthesia. 2021;76(1):91-100.

Czubryt M, Stecy T, Popke E, Aitken R, Jabusch K, Pound R, et al. N95 mask reuse in a major urban hospital: COVID-19 response process and procedure. Journal of Hospital Infection. 2020;106(2):277-82.

Dugdale CM, Walensky RP. Filtration efficiency, effectiveness, and availability of N95 face masks for COVID-19 prevention. JAMA Internal Medicine. 2020;180(12):1612-3.

Duncan S, Bodurtha P, Naqvi S. The protective performance of reusable cloth face masks, disposable procedure masks, KN95 masks and N95 respirators: Filtration and total inward leakage. PloS one. 2021;16(10):e0258191.

Hui DS, Chow BK, Chu L, Ng SS, Lee N, Gin T, et al. Exhaled air dispersion during coughing with and without wearing a surgical or N95 mask. PloS one. 2012;7(12):e50845.

Fikenzer S, Uhe T, Lavall D, Rudolph U, Falz R, Busse M, et al. Effects of surgical and FFP2/N95 face masks on cardiopulmonary exercise capacity. Clinical research in cardiology. 2020;109(12):1522-30.

Burki NK, Lee L-Y. Mechanisms of dyspnea. Chest. 2010;138(5):1196-201.

Berliner D, Schneider N, Welte T, Bauersachs J. The differential diagnosis of dyspnea. Deutsches Ärzteblatt International. 2016;113(49):834.

Hayen A, Herigstad M, Pattinson KT. Understanding dyspnea as a complex individual experience. Maturitas. 2013;76(1):45-50.

Meek PM, Banzett R, Parsall MB, Gracely RH, Schwartzstein RM, Lansing R. Reliability and validity of the multidimensional dyspnea profile. Chest. 2012;141(6):1546- 53.

McDonald CM, Henricson EK, Han JJ, Abresch RT, Nicorici A, Elfring GL, et al. The 6-minute walk test as a new outcome measure in Duchenne muscular dystrophy. Muscle & Nerve: Official Journal of the American Association of Electrodiagnostic Medicine. 2010;41(4):500-10.

Kisielinski K, Giboni P, Prescher A, Klosterhalfen B, Graessel D, Funken S, et al. Is a mask that covers the mouth and nose free from undesirable side effects in everyday use and free of potential hazards? International journal of environmental research and public health. 2021;18(8):4344.

Kim J, Yoo S, Kwon OS, Jeong ET, Lim JM, Park SG. Influence of quarantine mask use on skin characteristics: One of the changes in our life caused by the COVID-19 pandemic. Skin Research and Technology. 2021;27(4):599-606.

Shein SL, Whitticar S, Mascho KK, Pace E, Speicher R, Deakins K. The effects of wearing facemasks on oxygenation and ventilation at rest and during physical activity. PLoS One. 2021;16(2):e0247414.

Dacha S, Chuatrakoon B, Sornkaew K, Sutthakhun K, Weeranorapanich P. Effects of wearing different facial masks on respiratory symptoms, oxygen saturation, and functional capacity during six-minute walk test in healthy subjects. Canadian Journal of Respiratory Therapy: CJRT= Revue Canadienne de la Thérapie Respiratoire: RCTR. 2022;58:85.