Original Article

Effect of face veil on ventilatory function among Saudi adult females

Ahmad Alghadir[1], Farag Aly[2], Hamayun Zafar[3]

Abstract

Objective: The use of face veil called "*niqab*" by women to cover their faces at public places is a common practice in some Muslim communities. The long-term effect of *niqab* use on ventilatory function (VF) has not previously been reported. The aim of this cross-sectional study was to compare VF between *niqab* wearing and non-*niqab* wearing healthy Saudi females.

Methodology: Thirty eight healthy adult Saudi females participated in this study. Nineteen subjects were regular *niqab* users and the other nineteen were either not using *niqab* at all or used it for less than one hour per day. Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC (%), and maximal voluntary ventilation (MVV) were recorded using a digital spirometer.

Results: Mean values of FVC, FEV1, FEV1/FVC (%) and MVV for *niqab* wearers were significantly lower than the corresponding values for non-*niqab* wearers. Significant negative correlation was found between the FVC and FEV1 values and the number of hours of the use of face veil per day.

Conclusions: Long-term use of traditional *niqab* use can affect VF.

KEY WORDS: Face veil, Ventilatory function test, Saudi, Healthy, Adult, Females.

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INTRODUCTION

Free and unobstructed airflow in the upper and lower respiratory tract during inspiration and expiration is a prerequisite for normal respiratory function. Any pathological or non-pathological condition that can compromise free airflow during respiratory cycle can result in hypoventilation with increased respiratory effort that can lead to physiological burden involving cardiovascular[1-3] and temperature regulatory system,[1] and can also cause psychological stresses.[4]

A large body of knowledge exists about possible mechanisms and short- and long-term physiological responses for different pathological airflow limiting conditions, involving the respiratory system endogenously, such as obstructive sleep apnea,[5] chronic obstructive pulmonary disease and asthma.[6] However, studies on physiological responses to external airflow limiting factors such as surgical and protective masks, are relatively few. Use of facemasks of different air permeability can cause changes in temperature and humidity in the microclimates of the facemasks, causing different effects on heart rate, thermal stress and perception of discomfort.[7] It is also shown that 1-4 hours use of surgical masks during surgeries can result in decreased arterial oxygen saturation levels and increased pulse rate in surgeons.[8]

1. Dr. Ahmad Alghadir, PT, PhD,
2. Dr. Farag Aly, PT, PhD,
Faculty of PT, Cairo University, Egypt.
3. Dr. Hamayun Zafar, PT, PhD,
Odontology Department, Clinical Oral Physiology,
Umea University, Sweden.
1-3: Rehabilitation Research Chair, King Saud University, Riyadh, Saudi Arabia.
1, 3: Rehabilitation Sciences Department, CAMS, King Saud University, Riyadh, Saudi Arabia.

Correspondence:

Dr. Ahmad Alghadir,
Department Rehabilitation Sciences, CAMS,
King Saud University,
PO BOX 10219, Riyadh 11433, Saudi Arabia.
E-mail: alghadir@ksu.edu.sa

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In some Muslim communities, women use face veil called "*niqab*" to cover their faces at public places. The use of *niqab* is more common in Arab gulf countries, and in Saudi Arabia it is a cultural norm and a social obligation for Saudi women to wear *niqab* at public places. Due to the similarity in which the use of facial mask and *niqab* can interfere with the normal airflow during respiration, it can be reasonable to draw an analogy between the use of facial masks and *niqab* with regard to the physiological responses. However, to the best of our knowledge, no previous data on physiological impact for short- or long-term use of *niqab* on the VF is available.

The spirometry data can help to study respiratory function and dysfunction in different conditions and diseases affecting the airflow in lungs during respiration,[9] and can also provide information about breathing reserve and exercise tolerance to determine fitness levels of healthy subjects.[10] For spirometry, the most commonly used parameters are vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and maximal voluntary ventilation (MVV). The VC is the maximum volume of air that can be expelled from the lungs after a maximum inspiration, FVC is the volume of air that can forcibly be blown out after full inspiration, FEV1 is the maximum volume of air that can be forcibly blown out in the first second during the FVC manoeuvre, and MVV is the maximum volume of air that can be inhaled and exhaled in one minute.[11] These VF values are gender dependent with lower values in females.[12]

We have previously shown that the parameters of VF tests in Saudi subjects are lower than the Caucasian reference values, and these gender related differences for Saudi adults is larger than corresponding differences in Caucasian population.[13] Based on the analogy between the use of facial masks and *niqab* with regard to the physiological responses, it can be assumed that the long-term use of *niqab* can have an impact on the VF of its user. It is hypothesized that the VF values would be lower for face veil users than non-face veil users.

The aim of this study was to compare VF values off face veil users and non-face veil users among healthy Saudi adult females.

METHODOLOGY

Subjects: Thirty eight healthy Saudi females (aged 18-31 years; mean age 24) participated in this study. Nineteen subjects were regular *niqab* users (minimum of 3 years for 4 hours per day) (veil group), and nineteen subjects were either not using *niqab* at all or for less than one hour per day (non-veil group). Users of any tobacco products and obese subjects with body mass index (BMI) >25kg/m^2 were excluded. General characteristics of subjects are shown in Table-I.

Measurements and Procedures: This study was performed at the Cardiopulmonary Laboratory, CAMS, King Saud University. The standing height without shoes (cm), and weight (kg) for calculation of BMI, and age and number of hours of *niqab* use per day was noted for each subject. The investigation was approved by the Ethics committee of Rehabilitation Research Chair, King Saud University. All subjects gave their informed consent to be part of the study. The VF tests were conducted in accordance with 'Guidelines for Standardization of Spirometry'[14] using a portable spirometer Pony Fx (COSMED, Rome, Italy). Subjects were given detailed information about all test procedures and were asked to practice the test manoeuvre before the actual test. The spirometer was calibrated daily and tests were conducted between 9 am to 12 noon to minimize diurnal variation,[15] at room temperature between 20-25^{o}C. The FVC, FEV1, and MVV were recorded while subjects were seated comfortably in a chair. The FEV1/FVC% was later calculated. Each manoeuvre was performed for three to five times by every subject, and the largest value for each parameter was selected.[14]

Statistical Analysis: Mean and SD were used for descriptive statistics. The FVC, FEV1, FEV1/FVC (%) and MVV mean values for the face veil group and non-face veil group were compared by one-tail unpaired t-test with a significance level of

Table-I: Mean, standard deviation (SD) and range of age, weight, height and BMI for healthy face veil and non-face veil using Saudi women (n = 19, each group).

Subjects	*Age range (years)*	*Age (mean± SD)*	*Weight Range(kg)*	*Weight(kg) (mean± SD)*	*Height range (cm)*	*Height(cm) (mean± SD)*	*BMI range (kg/m2)*	*BMI (mean± SD)*
Non-face veil group (n= 19)	19-31	24.4 ± 2.9	51-74	58.5 ± 6.7	152-168	158.3 ± 4.8	19.4-28.5	23.3 ± 1.9
Face veil group (n=19)	18-31	23.7 ± 3.2	50-79	59.8 ± 7.0	149- 180	159.1 ± 6.9	19.3-27.4	24.0 ± 2.4
p -value		0.74		0.26		0.94		0.93

Table-II: Mean, SD and statistical comparison between mean values of different VF parameters for healthy face veil and non-face veil using Saudi women (n = 19, each group).

Parameters	*Non-face veil group (mean± SD)*	*Face veil group (mean± SD)*	*Mean difference*	*% of difference*	*p-value*
FVC (litres)	3.4 ± 0.3	2.6 ± 0.4	0.8	30 %	<0.001
FEV1 (litters/sec)	2.6 ± 0.5	1.9 ± 0.3	0.7	28%	<0.001
FEV1/FVC (%)	80.6 ± 3.6	72.6 ± 3.1	8.0	9%	<0.001
MVV (litres/min)	62.9 ± 9.0	45.6 ± 7.6	17.3	28%	<0.001

FVC= Forced vital capacity, FEV1= forced expiratory volume in one second, MVV= maximal voluntary ventilation.

<0.05. The Pearson product moment correlation coefficient test was used to test the presence of any linear relationship between the number of hours of veil use per day and the values of VF parameters. The software SPSS version 10, was used for all statistical analyses.

RESULTS

Table-II shows the mean and SD values of FVC, FEV1, FEV1/FVC (%) and MVV for face veil and non-face veil groups. The values for all parameters were significantly lower in veil group than the non-veil group.

Correlation statistics revealed significant negative relationship between number of hours of wearing face veil per day and FVC (r=0.9, p-value = 0.0001) and the FEV1(r=0.8, p-value = 0.0001), respectively. However, correlation between number of hours of wearing face veil per day and FEV1/FVC (%) (r=0.215, p-value = 0.19) and MVV (r=0.188, p-value =0.22) was not significant.

DISCUSSION

To the best of our knowledge, this is the first study on the effect of *niqab* use on the ventilatory function. The present results show that VF values (FVC, FEV1, FEV1/FVC (%) and MVV) for *niqab* wearing females were significantly lower than the corresponding values for non-*niqab* wearing females. In fact, the FVC, FEV1 and MVV values were approximately 30% lower, and the FEV1/FVC (%) was 9% lower for *niqab* wearing females. The data also show a significant negative correlation between the duration of *niqab* use and the FVC and FEV1 values.

It is reasonable to believe that any condition, pathological or otherwise, which can interfere with the free airflow in the respiratory system or adequate expansion of lungs and chest wall, can result in insufficient ventilation or excessive work of respiratory muscles to maintain required ventilation. Previous studies show that different conditions limiting chest expansion during respiration, such as obesity, scoliosis or use of bullet proof vests, body armour and heavy backpacks can reduce FVC and FEV1, without affecting the FVC/FEV1 ratio.[16-18] These results indicate a proportionate reduction in FEV1 and FVC values. However, our present results show that FEV1/FVC% value for *niqab* wearing females was significantly lower than the non-*niqab* wearing females. This indicates that with long-term use of *niqab,* the FEV1 was relatively reduced more than the FVC.

Although data on the changes in VF related to different pathological airflow limiting conditions such as obstructive sleep apnea,[5] chronic obstructive pulmonary disease and asthma[6] are available, but data on changes in VF related to non-pathological airflow limiting conditions with use of protective masks are not available. A few previous studies on the use of facial masks[7,8] only reported short-term physiological responses (heart rate, thermal stress and oxygen saturation). Thus, our present data add new knowledge on the effect of long-term use of *niqab* on VF.

It has been reported that with increased physical activity the temperature in the facemask microclimate increases,[7,19]causing increase in thermal sensations of the whole body[20], which decreases work endurance.[21]The temperature of air entering the facemask during inspiration corresponds to thermal stimulus to the skin under mask and affects heat exchange from the respiratory tract, reducing breathing comfort sensation.[22] Decrease in blood oxygenation level among surgeons has also been reported following the use of surgical masks during surgery lasting 1 to 4 hours,[8]and long duration use of facemasks by medical emergency staff has been related to extreme stress.[23]

Taken together, it is reasonable to believe that the short-term physiological responses to the use of *niqab* maybe similar to those previously described for different kinds of facial masks. It can be argued that unlike the facial masks, the *niqab* is usually not very tightly applied to the face, and thus the thermal and circulatory changes that occur when wearing a surgical mask may not be applicable. However, in comparison to the facial masks that cover mainly the nose and mouth, the *niqab* used by

Saudi women covers the whole face except the eyes and is thus maybe capable of causing facial mask like short-term physiological responses. In fact, increased breathing discomfort during summer is a common complaint among our *niqab* wearing subjects corroborating previous studies.[19,22] No data is available on the air and moisture permeability of the layers of fabric used in making the *niqab*. It has been reported that use of two different kinds of facemasks with 95% and 96% filtration efficiency, can result in different mean heart rate, microclimate temperature, humidity and skin temperature under facemask, together with perceived discomfort, fatigue and breathing resistance.[7] In light of these previous findings, it is reasonable to speculate that the present result of lower VF values in veil group than non-veil group, is not only due to direct airway resistance caused by *niqab*, but increase in microclimate temperature, humidity and skin temperature inside the *niqab* can be contributing factors. In addition, it is a possibility that part of the exhaled carbon dioxide may also be trapped inside the *niqab*, leading to some shortage of oxygen causing an increase in heart rate via sympathetic nervous system.[24]

Furthermore, the use of *niqab* in presence of known sedentary life style of Saudi females probably does not require extra respiratory effort to overcome physiological responses to the use of *niqab*, as these ladies may adapt to shallow breathing patterns with higher heart rate. Prolonged reduction of pulmonary ventilation during the use of *niqab* for several hours may result in lowering the tidal volume, which may induce insufficient oxygenation and inadequate carbon dioxide elimination. This affects gas exchange[15] and thus can cause some degree of hypoxia, which may lead to different musculoskeletal pain disorders and reduction in endurance levels. We can also speculate that the regular use of *niqab* by Saudi women can probably be one of the reasons of higher prevalence of fibromyalgia and cervicobrachialgia among Saudi females.[25]The present results of lower VF values in veil group than non-veil group, merit further investigations where different physiological responses, blood oxygen saturation levels and subjective perception of discomfort should be investigated during different levels of physical activity with *niqab* made of different air and moisture permeability.

In conclusion, our data show that there are differences in VF tests among *niqab* and non-*niqab* wearing Saudi adult females, where values for *niqab* users are lower than the values for those who do not use *niqab*. Further studies are required to investigate the effect of different fabric materials with different air and moisture permeability that can safely be used for *niqab* with minimal effect on ventilatory function.

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