ORIGINAL ARTICLE

Pulmonary function tests and respiratory symptoms among smokers in the city of Mashhad (north east of Iran)

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Abstract The prevalence of smoking was studied using a questionnaire. Pulmonary function tests and respiratory symptoms were evaluated in 176 smokers. The total studied population with family and co-workers were 13289. The number of smokers among studied population was 11.7%. The rate of smoking among male subjects was 17.2% and in female 2.5%. All values of PFTs in smokers were significantly lower ($p < 0.001$) and respiratory symptoms higher than in non smokers ($p < 0.05$ for cough and $p < 0.001$ for wheeze and tightness). There were significant negative correlations between smoking duration and rate with values of PFT ($p < 0.05$-$p < 0.001$). In this study the prevalence of smoking in population of Mashhad city was shown. The prevalence of smoking was higher among male than females. Smoking leads to increased respiratory symptoms and reduction of PFTs values.

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PALABRAS CLAVE
Prevalencia del acto de fumar; duración del acto de fumar; cantidad del acto de fumar; testes de función pulmonar; sintomas respiratorios

Testes de função pulmonar e sintomas respiratórios em fumadores iranianos

Resumen A prevalência do acto de fumar foi estudada através de um questionário. Os testes de função pulmonar e sintomas respiratórios foram avaliados em 176 fumadores. O total da população estudada com família e colaboradores foi de 13289. O número de fumadores entre a população estudada foi de 11.7%. A taxa do acto de fumar entre os homens foi de 17.2% e de 2.5% entre as mulheres. Todos os valores de TFP nos fumadores foram significativamente inferiores ($p < 0.001$) e os sintomas respiratórios foram superiores em relação aos não fumadores ($p < 0.05$ para tosse e $p < 0.001$ para pieira e aperto torácico). Registaram-se correlações negativas significativas entre a duração do acto de fumar e a taxa com valores de TFP ($p < 0.05$-$p < 0.001$). Neste estudo, foi apresentada a prevalência do acto de fumar na população da cidade de Mashhad.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity throughout the world. Many people suffer from this disease for years and die prematurely from it or its complications. COPD is currently the fourth leading cause of death in the world and further increases in its prevalence and mortality can be predicted in the coming decades.

Cigarette smoking is by far the most important risk factor for COPD and the most important way that tobacco contributes to the risk of COPD. Cigarette smokers have a higher prevalence of respiratory symptoms and lung function abnormalities, greater annual rate of decline in FEV1, and a greater COPD mortality rate than non-smokers. These differences between cigarette smokers and non-smokers are in direct proportion to the quantity of smoking. Smoking leads to rapid decline in pulmonary function tests (PFTs) specially those indicating diameter of the airways such as forced expiratory flow in one second (FEV1). Even in teenagers who have smoked only a few years, maximum expiratory flow-volume curves demonstrate decreases in flow rates at small lung volumes, yet another expression of small airway constriction in COPD and decline in PFTs.

Therefore, in the present study the prevalence of smoking in the city of Mashhad and the effect of quantity and duration of smoking on PFTs and the respiratory symptoms were examined.

Methods

Study area and population

The data of directly interviewed subjects (1435 subjects including 999 male and 436 female) and their relatives (totally 13289 subjects) aged 10 year and over (Table 1) regarding prevalence of smoking were collected from 21 randomly selected areas in the city of Mashhad using clustering sampling method and a list of different areas of the city. The city of Mashhad has moderate industry and heavy traffic. Mashhad is a holy city located in the north east of Iran with a population of two-million people, many of whom are immigrants from all over Iran.

Protocol

A Farsi questionnaire was used to assess the prevalence of smoking among population of the city of Mashhad and the respiratory symptoms. The questionnaire included two different parts: 1) part (a) questions on regular smoking, amount and duration of smoking and 2) part (b) respiratory symptoms (wheezing, tightness, cough and sputum).

The interviewed subjects were asked the questions from both parts but relatives of interviewed subjects were only asked questions from part (a). In addition, 150 non smokers of similar age and sex distribution were interviewed and their respiratory symptoms were evaluated as a control group. The studied (interviewed subjects) were interviewed face to face by two trained final medical students. The questionnaire was validated in our two previous studies.

The questionnaire on respiratory symptoms was designed in accordance with several previous questionnaires of similar studies by expert groups (Table 2).

Pulmonary function tests of smokers and control groups were measured using a spirometer with a pneumotachograph sensor (Model ST90, Fukuda, Sangyo Co., Ltd. Japan). Prior to pulmonary function testing, the required manoeuvre was demonstrated by the operator, and subjects were encouraged and supervised throughout the test performance. Pulmonary function testing was performed using the acceptability standards outlined by the American Thoracic Society (ATS) with subjects in a standing position and wearing nose clips. All tests were carried out between 1000 and 1700 hours. Pulmonary function tests were performed three times in each subject with an acceptable technique. Subjects were educated prior to PFT measurements regarding the PFT performance. PFT measurements were carried out three times in each subject and there were small variation among three measurements. The highest level for forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow (PEF), maximal mid expiratory flow (MMEF) and maximal expiratory flow at 75%, 50%, and 25% of the FVC (MEF75, MEF50, and MEF25 respectively) were taken independently from the three curves. The study was...
Pulmonary function tests and respiratory symptoms among smokers in the city of Mashhad (north east of Iran)

<table>
<thead>
<tr>
<th>Table 2</th>
<th>The criteria for asthma severity score.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom</td>
<td>Frequency</td>
</tr>
<tr>
<td>Wheezing</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>During mild exercise (walking)</td>
</tr>
<tr>
<td></td>
<td>During heavy exercise</td>
</tr>
<tr>
<td></td>
<td>At rest</td>
</tr>
<tr>
<td>Cough</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>During mild exercise (walking)</td>
</tr>
<tr>
<td></td>
<td>During heavy exercise</td>
</tr>
<tr>
<td></td>
<td>At rest</td>
</tr>
<tr>
<td>Tightness</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>During mild exercise (walking)</td>
</tr>
<tr>
<td></td>
<td>During heavy exercise</td>
</tr>
<tr>
<td></td>
<td>At rest</td>
</tr>
<tr>
<td>Sputum</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Small volumes of non purulent sputum</td>
</tr>
<tr>
<td></td>
<td>Large volumes of non purulent sputum</td>
</tr>
<tr>
<td></td>
<td>Purulent sputum</td>
</tr>
<tr>
<td>Total score</td>
<td></td>
</tr>
</tbody>
</table>

Table approved by the ethical comity of Mashhad University of Medical Sciences.

Data analysis

Based on the prevalence of smoking in Iran,17,18 using the PPS sampling method, it was calculated that a minimum of 1300 subjects (900 male and 400 female) would be needed to detect a 5% difference with an error of 1% and a power of 95%. Therefore, 1435 subjects including 999 male and 436 female were interviewed. The data of PFT values and age were expressed as mean ± SD and data of smoking and respiratory symptoms as percentage of each group having the correspond symptom. Differences in the data of symptoms between smokers and control group were tested by Chi-Squared analysis on 2X2 contingency tables. The data of PFT values between smokers and control group were compared using unpaired t test. The relationships between PFT values and respiratory symptoms with duration and quantity of smoking were performed using regression analysis. A two-sided p value of 0.05 was the criterion for statistical significance. All analyses were performed with SPSS software (version 11.5, SPSS Inc. USA).

Results

Prevalence of smoking

The prevalence of smoking among all studied individuals including relatives of interviewed subjects was 11.7% (1554 out of 13289 subjects), (Table 3).

Smoking was more prevalent among population of Golshar area and less prevalent in Ahmad Abad area (a poor and rich populated area of Mashhad city respectively). Generally smoking was more prevalent in poorer populated area of the city (Table 3). The prevalence of smoking was much lower in female (2.5%) compared to male (17.2) subjects.

Respiratory symptoms

The most and the least prevalent respiratory symptoms among smokers were tightness and cough respectively. About one third (34%) of smokers reported tightness and only 17% had cough symptom. However, the prevalence of all respiratory symptoms among smokers was higher compared to those in control group which was statistically significant except sputum (p < 0.05 to p < 0.001), (Table 4).

The severity of most respiratory symptoms was also greater in smokers compared to non smoker subjects which

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Comparison of respiratory symptoms severity between smokers and non-smokers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory symptoms</td>
<td>Smokers</td>
</tr>
<tr>
<td>Wheezing</td>
<td>0.48 ± 0.88</td>
</tr>
<tr>
<td>Tightness</td>
<td>0.62 ± 0.90</td>
</tr>
<tr>
<td>Cough</td>
<td>0.28 ± 0.67</td>
</tr>
<tr>
<td>Sputum</td>
<td>0.25 ± 0.53</td>
</tr>
</tbody>
</table>

Values were presents as mean ± SD, NS: non significant differences. Differences in the data of symptoms between smokers and control group were tested by Chi-Squared analysis on 2X2 contingency tables.
was statistically significant for wheezing and breathlessness (p < 0.05 for both cases), (Fig. 1).

**Pulmonary function test**

Although some values of pulmonary function tests in smokers were around normal range of 80% predicted values (MFEF, MEF50 and MEF25), all values of PFT among smokers were significantly lower than those of non-smokers (p < 0.001 for all cases), (Fig. 2).

**Table 5** Relationship between respiratory symptoms in smokers with smoking duration (year) and amount (pack/year).

<table>
<thead>
<tr>
<th>Respiratory symptoms</th>
<th>Duration R</th>
<th>Amount P</th>
<th>R</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheezing</td>
<td>0.158</td>
<td>0.087</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Tightness</td>
<td>0.146</td>
<td>0.088</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td>0.044</td>
<td>0.027</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Sputum</td>
<td>0.141</td>
<td>0.036</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

NS: non significant differences. The relationships between respiratory symptoms with duration and quantity of smoking were performed using regression analysis.

**Table 6** Relationship between pulmonary function tests (PFT) of smokers with smoking duration (year) and amount (pack/year).

<table>
<thead>
<tr>
<th>PFT Values</th>
<th>Duration R</th>
<th>Amount P</th>
<th>R</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>-0.224</td>
<td>-0.127</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>EFV1</td>
<td>-0.282</td>
<td>-0.163</td>
<td>p &lt; 0.05</td>
<td></td>
</tr>
<tr>
<td>MMEF</td>
<td>-0.306</td>
<td>-0.137</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>PEF</td>
<td>-0.241</td>
<td>-0.121</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>MEF75</td>
<td>-0.247</td>
<td>-0.170</td>
<td>p &lt; 0.05</td>
<td></td>
</tr>
<tr>
<td>MEF50</td>
<td>-0.305</td>
<td>-0.144</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>MEF25</td>
<td>-0.236</td>
<td>-0.072</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

NS: non significant differences.

**Relationship between smoking duration and amount with pulmonary function tests and respiratory symptoms of smokers**

The relationship between respiratory symptoms for only wheezing with duration of smoking (year) was statistically significant (p < 0.05), (Table 5). There were significant negative relationships between duration of smoking with all PFT values (p < 0.01 to p < 0.001) and amount of smoking (pack/year) with only FEV1 and MEF75 (p < 0.05 for both cases), (Table 6).

**Discussion**

In the present study which was performed in a relatively large population sample, the prevalence of smoking in the city of Mashhad (north east Iran) was studied. The respiratory symptoms and PFT values of smokers in comparison to non-smokers were also evaluated. The results showed that 11.7% of the population of the city are regular smokers. The results also indicated that prevalence of smoking is higher among population of poor area of the city.

The prevalence of smoking was much lower in female (2.5%) compared to male (17.2) subjects.

The results of study of Ahmadi et al. showed higher prevalence of smoking in the city of Shiraz (18.7%). The sample population of their study was smaller compared to the present study which might be the reason for the differences in the prevalence of smoking between two
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In conclusion, the results of the present study showed an 11.7% prevalence of smoking among population of the city of Mashhad. The prevalence of smoking was significantly higher among males than females. The results also demonstrated the profound effect of smoking on PFTs specially those indicating large airways. There were also increased respiratory symptoms among smokers.

Conflict of interests

Authors declare that they don’t have any conflict of interests.

Acknowledgements

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References