During the last few years, anthracosis and anthraco-tuberculous have found great interest between pulmonologists of Iran and some other parts of the world as a newly emerging medical condition associated with high tuberculous burden. A recent report from World Health Organization (WHO) consider indoor air pollution from old fashion household cooking fires as the most important environmental cause of mortality and morbidity which is the etiology of at least 2 million deaths across the world each year. This primitive household cooking which uses biomass (dung, wood, charcoal and crop residues) results in old fashion homes filled with dense smoke, blacking walls and ceilings and sickening women and children in low income countries. The risk of these types of exposures is equal to lifelong smokers of tobacco and result in annual deaths of 872,000 children under age 5 from acute lower respiratory infections, 1,057,000 adults from COPD, 36,000 adults from lung and upper respiratory cancers, and increasing numbers of car which is now the main source of air pollution. This will affect both the old and the new generation of people living and working in Iran and other low and middle income countries. So the increasing prevalence of this kind of deposition disease is related to increasing air pollution and industrialization of our country. We should anticipate its adverse effect on our children’s health who are living in polluted areas with vulnerable lungs and what will happen in coming decades.

Studies in anthracosis have shown a spectrum of disease from simple mucosal to severe anthracofibrosis with or without associated tuberculosis. Since the introduction of fiberoptic bronchoscopy and availability of respiratory specialist all over the country, what we have seen 25 – 30 years ago in coal miners or household rural baker women, now is reported with increasing frequency from various states of Iran even in peoples without evidence of occupational exposure. Carbon is essential element of combustion of biomass and fossil fuels (e.g. diesel exhaust) and increasing prevalence of anthracosis especially in air polluted and dirty areas of the world is related to air quality. Studies on carbon deposition and clearance have showed that if the quantity of deposition became more than the clearance capacity of the lungs, carbon particle retained in the alveoli and transferred to lymphatics with some fibroptic reaction and may distribute through the lymphatics to other organs. Surprisingly, in smokers, due to increased mucociliary clearance, the deposition of carbon was less than non-smokers. The role of air pollution in producing anthracosis regardless of human being has been documented in animals, which have no occupational exposure, no traditional bakery, and no smoking history. In Dhaka zoo collections, Ahasan et al in necropsy of animals have showed that between 36 samples of 24 different species, 27 cases had anthracosis, which was related to Dhaka city air pollution. In another study by Beytut from Turkey, the presence of anthracosis was also established in 2.25% of 2000 slaughtered sheep.

During last 30 years, we have witnessed a dramatic change in socioeconomic status of low income people in Iran with improve housing and special replacement of natural gas as the most common source of energy for cooking and warming across the country which include almost all urban population and a significant portion of rural population. This has resulted in significant reduction in indoor air pollution from old fashion household cooking fires. This event coincided with industrialization of our country and increasing numbers of car which is now the main source of air pollution. This will affect both the old and the new generation of people living and working in Iran and other low and middle income countries. So the increasing prevalence of this kind of deposition disease is related to increasing air pollution and industrialization of our country. We should anticipate its adverse effect on our children’s health who are living in polluted areas with vulnerable lungs and what will happen in coming decades.

Studies in anthracosis have shown a spectrum of disease from simple mucosal anthracosis to advanced fibrotic disease with distortion of bronchi associated with mild to severe ventilatory disturbance of obstructive, restrictive, or mixed types. Regarding published studies, the small amounts of carbon particles have no fibrogenic effect, but large ones may give rise to fibrosis especially in lymphatics and nodes and this may distort the lung architecture. But even in these cases the role of other particles and minerals should not be ignored. Carbon particles are rarely pure and usually combined with various minerals and metals like iron, nickel, silica and mica. Thus, the fibrosis which occurs in some patients may be related to mixed particles inhalation. No study from Iran answered this question, but scattered reports especially in rural bakery women from Africa, Latin/South America and India have revealed the nature of particles. Some of our patients clinical and radiologic characteristics are similar to these cases, so we cannot rule out the role of mixed dust inhalation. We watch only the black color of carbon at bronchoscopy but other minerals and metals were not detected by usual methods and they should be studied by other methods like polarized light and transmission electron microscopy. Grobbelaar et al have studied 25 rural bakery women from Transki of South Africa with no history of tuberculosis, and other occupational exposure or mining. Histological picture of these mostly asymptomatic patients were in favor of simple anthracosis (12 patients), anthracosis with macules (6 patients), and mixed dust fibrosis (7 patients). In this study, silica (quartz) was attributed to fibrotic process. The contribution of other particles in anthracosis and potentiating of mixed dust theory also has been revealed by Naccache et al who reported three cases of anthracofibrosis without tuberculosis due to mixed dust. These three patients have had free crystalline silica, mica, kaolin and other silicates on transmission electron microscopy in addition to black pigment of carbon.

Studies on anthracosis particularly in coal mine workers about 100 years ago, when the prevalence of tuberculosis was high in the community, have revealed protective and bordering effect of fibrosis of anthracotic lesions for tuberculosis. Epidemiologic work Wainwright et al in 19th century in USA and UK found
that prevalence and mortality of tuberculosis in coal miners was lower between all other occupations. For example, TB death rate/100000 people was 540.5 for marble and stone cutters compared to 120.9 for miners and quarrymen. In this study the rate of tuberculosis in miners and quarrymen was less than lawyers and physicians (168.8/100000) but slightly higher than farmers (110/100000).43 A few years later, Haythorn in his experience on anthracosis proved that, both carbon granule and tubercle bacilli engulfed by alveolar macrophage (endothelial leukocyte), other cells has negligible role in phagocytosis. Moreover the presence of carbon within these cells did not interfere with granuloma reaction to mycobacterium, and pigment bearing cell around the granuloma promote fibrosis and encapsulation of the lesion, and then obliteration of lymphatics by anthracotic process can prevent spread of bacilli and localize the lesion.44 

It seems that other factors instead of carbon alone are important for predisposition to tuberculosis. Behera et al have found that Indian Women using domestic cooking fuels, have high Odd ratio for getting tuberculosis due to low socioeconomic state, poor ventilation of cooking place (cooking inside v/s open place), however, type of fuels has not significant effect on involving with tuberculosis.45 In a recent study in China, Hong-Min Fan et al have reported TNF-Î· -308 G/A Gene polymorphisms were associated with pulmonary tuberculosis in coal miner pneumoconiosis.46 According to Chaudhry et al.36 if increasing mucociliary clearance by smoking can prevent or decrease the process of anthracosis, we assume that tuberculosis by impairment in clearance mechanisms may increase the deposition and remaining of carbon particles in the lung. Overall, it seems that, not carbon alone but presence of other predisposing factors like quartz (silica), living and working

<table>
<thead>
<tr>
<th>Author /city</th>
<th>Date of article</th>
<th>Study period</th>
<th>Anthracosis No</th>
<th>FOB No</th>
<th>Smoking %</th>
<th>Presence of Occupation</th>
<th>Risk %</th>
<th>M/F</th>
<th>TB No (%)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoli17/Tehran</td>
<td>1994</td>
<td>85–90</td>
<td>10</td>
<td>---</td>
<td>Neg</td>
<td>Bakery /100</td>
<td>1/9</td>
<td>2</td>
<td>Smear + Culture -</td>
<td></td>
</tr>
<tr>
<td>Amoli2/Tehran</td>
<td>1998</td>
<td>86–95</td>
<td>10</td>
<td>891</td>
<td>Neg</td>
<td>Bakery /100</td>
<td>0/10</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towhid1/Mashhad</td>
<td>2002</td>
<td>98–20</td>
<td>29</td>
<td>1118</td>
<td>---</td>
<td>---</td>
<td>9/20</td>
<td>29 (100)</td>
<td>17 granuloma 15 AFB+</td>
<td></td>
</tr>
<tr>
<td>Aslani3/Tehran</td>
<td>2002</td>
<td>98–01</td>
<td>96</td>
<td>919</td>
<td>---</td>
<td>38.5%</td>
<td>44/52</td>
<td>26 (27)</td>
<td>Tb in Control?</td>
<td></td>
</tr>
<tr>
<td>Najafizadeh4/Tehran</td>
<td>2003</td>
<td>4 months</td>
<td>47</td>
<td>290</td>
<td>10.6</td>
<td>30%</td>
<td>24/23</td>
<td>13(27.7)</td>
<td>7.3% urban S+ = 11.2%, c+ = 13.5% Path = 5 (10.6)</td>
<td></td>
</tr>
<tr>
<td>Amoli10/Tehran</td>
<td>2004</td>
<td>75–20</td>
<td>819</td>
<td>11664</td>
<td>---</td>
<td>91</td>
<td>430/319</td>
<td>23(2.8)</td>
<td>S+ = 14 C+ = 9</td>
<td></td>
</tr>
<tr>
<td>Mursadrae11,12/Mashhad</td>
<td>2005</td>
<td>2003</td>
<td>189</td>
<td>19</td>
<td>91% house 46% Farmer</td>
<td>95/94</td>
<td>52/172(30)</td>
<td>S+ = 22 C+ = 42/163 Path = 18/102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rezaeitalab13/Mashhad</td>
<td>2006</td>
<td>2002–2004</td>
<td>225</td>
<td>1000</td>
<td>---</td>
<td>14%</td>
<td>93/132</td>
<td>(25.3)</td>
<td>Tb in non-anthracotics</td>
<td></td>
</tr>
<tr>
<td>Hemmati14/Zahedan</td>
<td>2008</td>
<td>2003–2006</td>
<td>34</td>
<td>207</td>
<td>---</td>
<td>33%</td>
<td>15/19</td>
<td>15/34 (44)</td>
<td>Tb in non-anthracotic = 30/173 (17.4)</td>
<td></td>
</tr>
<tr>
<td>Najafizadeh15/Tehran</td>
<td>2008</td>
<td>7 months 2006</td>
<td>87</td>
<td>87</td>
<td>11.5</td>
<td>6.9% urban 30% fire work</td>
<td>57/30</td>
<td>23/87 (26)</td>
<td>MT EAI = 11 CAS = 7 Haarlem = 4 T clade = 1</td>
<td></td>
</tr>
<tr>
<td>Sigari16/Tehran &amp; Sanandaj</td>
<td>2009</td>
<td>1982–2006</td>
<td>778</td>
<td>14300</td>
<td>---</td>
<td>98%F housework 41% M farmer 30%M manual work 7.5% miner 86% rural</td>
<td>399/379</td>
<td>---</td>
<td>No work about TB</td>
<td></td>
</tr>
<tr>
<td>Amoli17/Tehran</td>
<td>2009</td>
<td>1975–2000</td>
<td>102</td>
<td>205</td>
<td>64</td>
<td>50% Housewife 6% farmer 30% Worker Rustic F 100%, M 48% Urban M 52%</td>
<td>42/60</td>
<td>27/102(26.4)</td>
<td>19/103 non-anthracotics(18.4) had TB</td>
<td></td>
</tr>
<tr>
<td>Fekri19/Kerman</td>
<td>2010</td>
<td>2003–2007</td>
<td>333</td>
<td>1594</td>
<td>---</td>
<td>148/158 (6.9)</td>
<td>2.7% of non-anthracotics had TB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghaffari20/Tabriz</td>
<td>2010</td>
<td>2004–2006</td>
<td>9</td>
<td>9</td>
<td>42 Baker women</td>
<td>0/42</td>
<td>42/150</td>
<td>Not mentioned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ghanei21/Tehran</td>
<td>2011</td>
<td>1998–2001</td>
<td>71</td>
<td>919</td>
<td>---</td>
<td>Oce = 42% Bakery = 27% Miner = 11.5%</td>
<td>32/39</td>
<td>41/71 (58)</td>
<td>10.6% of non-anthracotics had TB</td>
<td></td>
</tr>
<tr>
<td>Pazoki22/Tehran</td>
<td>2011</td>
<td>---</td>
<td>150</td>
<td>58 smoke</td>
<td>35 bakery</td>
<td>88/62</td>
<td>42/150</td>
<td>TB s/c + = 32 Path = 10 Smear+ =10 BAL+ =17 C+ =5 Close contact = 16, 12 with active TB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Summary of Iranian publications about anthracosis and tuberculosis.
in crowdy, poor ventilated or polluted areas and possibly genetic factors are important for predilection of anthracotic patients to tuberculosis. Further epidemiologic and pathologic surveys are needed to answer clearly these questions.

Retrospective studies have limitations due to lack of sufficient and effective data for good conclusion. In these 17 articles, only a few have noticed the standards of isolation, culture of mycobacteria and correlation of smear and culture to see what is (are) reported is (are) Mycobacterium Tuberculosis.11–13,15,18 There is a lot of reports about the contamination of fiberoptic bronchoscopes and washing machines with mycobacteria including saprophytic ones. Every research which includes bronchoscopy and BAL for Mycobacterium tuberculosis and other Mycobacteria should consider the methodology and standards of isolation, culture of Mycobacteria and its pitfalls. In conditions that AFB smear is positive and culture is negative, for example, in Amols’s study, how we can sure that we are confronting with only Mycobacterium tuberculosis. The importance of looking for non-tuberculous mycobacteria have been mentioned previously by Korean team and others.52–49 Prospective population based and controlled studies with good design are needed to resolve the answers which are not solved by previous studies. In these 17 reports only five studies had control patients,13,14,17,18,20 and only in last study the history of close contact to tuberculosis as a contributory factor has been clearly notified.4

In conclusion, we need more controlled studies to fill the knowledge gap regarding prevalence, trend, complicating factor(s), and associations that we have found up to this time in anthracosis.

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A view of the Rayen Mudbrick Castle in Kerman Province, Iran, Sassanid era. Hazar Mountain is seen in the background (Photo by S. Borzabadi Msc, 2012).