Ekrem YAZICIOĞLU

M.S. Thesis in Environmental Engineering

December - 2011

# AIR "CRITERIA POLLUTANTS" AND HEALTH INDICATORS: BRIDGING THE GAP FROM SOURCES TO HEALTH OUTCOMES AS A CASE STUDY IN MUĞLA CITY

by

Ekrem YAZICIOĞLU

December 2011

# AIR “CRITERIA POLLUTANTS” AND HEALTH INDICATORS: BRIDGING THE GAP FROM SOURCES TO HEALTH OUTCOMES AS A CASE STUDY IN MUĞLA CITY

by

Ekrem YAZICIOĞLU

A thesis submitted to

the Graduate Institute of Science and Engineering

of

Fatih University

in partial fulfillment of the requirements for the degree of

Master of Science

in

Environmental Engineering

December 2011
Istanbul, Turkey

# APPROVAL PAGE

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

_____
Assist. Prof. Dr. Sami GÖREN
Head of Department

This is to certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

_____
Assist. Prof. Dr. İffet İrem UZONUR
Supervisor

Examining Committee Members

Assist. Prof. Dr. İffet İrem UZONUR _____

Assist. Prof. Dr. Gökçe TEZCANLI GÜYER _____

Assist. Prof. Dr. Mutafa PETEK _____

It is approved that this thesis has been written in compliance with the formatting rules laid down by the Graduate Institute of Sciences and Engineering.

_____

Assoc. Prof. Nurullah ARSLAN
Director

December 2011

# AIR "CRITERIA POLLUTANTS" AND HEALTH INDICATORS: BRIDGING THE GAP FROM SOURCES TO HEALTH OUTCOMES AS A CASE STUDY IN MUĞLA CITY

Ekrem YAZICIOĞLU

M. S. Thesis - Environmental Engineering
December 2011

Supervisor: Assist. Prof. Dr. İffet İrem UZONUR

## ABSTRACT

The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six principal air pollutants ("criteria" pollutants): Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxide ($NO_2$), Particulate Matter (PM) in two size ranges [< 2.5 μm ($PM_{2.5}$) and < 10 μm ($PM_{10}$)], Ozone ($O_3$), and Sulfur Dioxide ($SO_2$). Although associations have been identified between these pollutants and adverse health effects, considerable uncertainty remains regarding a) methods and approaches to understanding relationships between air pollution and health effects; b) which components (gas and/or aerosol) and sources are most toxic; c) the mechanisms of actions of the pollutants and causal relationships; d) effect of confounding factors, and e) which populations are susceptible etc.

Global Alliance Against Chronic Respiratory Diseases (GARD) work on the above issues and in this thesis the data of GARD in Muğla city will be evaluated from the academical perspective to fullfill and bridge the gaps between the data available (criteria air pollutants, sources and airway diseases' epidemiological, in Muğla city) with the health outcomes.

**Keywords**: Air Pollution and Health Effects, $SO_2$, $PM_{10}$, Chronical Airway Diseases, GARD, Muğla.

# HAVA KİRLİLİĞI VE SAĞLIK BAĞLANTISINI SORGULAMADA MUĞLA İLİ KRONİK HAVA YOLU HASTALIKLARI ÖRNEĞİ

Ekrem YAZICIOĞLU

Yüksek Lisans Tezi – Çevre Mühendisliği
Aralık 2011

Tez Danışmanı: Yrd. Doç. Dr. İffet İrem UZONUR

## ÖZ

Muğla İli, mevcut verilere göre hava kirliliğinin yoğun yaşandığı yerleşim yerlerinden biridir. Hava kirliliği ve kronik hava yolu hastalıklarının ilişkisi bilinse de, bunun tüm yönleriyle ortaya konulabildiği söylenemez. Kronik hava yolu hastalılarının önlenmesi veya sıkıntılarının azaltılması yönündeki çabaların yetersizliği ve bu yönde yeni araştırmalara ihtiyaç duyulduğu da çok açıktır.

Tezimizde, Muğla İli mevcut kirlilik verileri kaynaklarından alınmış; İlin doğal ve insan kaynaklı hava kirleticileri harita üzerinde belirlenmiş; kronik solunum yolu hastalık ham verileri de değerlendirilmiş ve ArcView 10 programıyla harita üzerinde yerleştirilmiştir. Mevcut veriler (hastalık verileri: toplam ve nüfusa oranlı hasta sayısı; kirlilik parametreleri: $SO_2$ ve $PM_{10}$; meteorolojik veriler; Muğla İli maden yatakları ve hava kirletici kaynakları) uygun sitelerden güncellenerek bar ve pasta grafikler şeklinde gösterilmiştir. Tez çalışmamızda mevcut ham veriler yorumlanabilir, üzerinde bilimsel değerlendirme ve tartışma yapılabilir, faydaya yönelik verilere dönüştürülmüş; Türkiye ve dünyadaki durumların karşılaştırılabildiği grafikler haline getirilmiştir.

**Anahtar Kelimeler**: Hava kirliliği ve Sağlık Sonuçları, Kronik Solunum Sistemi Hastalıklar, $SO_2$, $PM_{10,}$ GARD, Muğla.

# DEDICATION

To my dear, precious, and esteemed family and

To my parents

# ACKNOWLEDGEMENT

I would like to thank my thesis supervisor Assist. Prof. Dr. İffet İrem UZONUR. Her motivation, encouragement and power kept me doing all the work. Her academic activities will be references in my future academic studies.

I would like to thank head of our department Assist. Prof. Dr. Sami GOREN and Assoc. Prof. Gökçe TEZCANLI GÜYER for her encouraging contributions and educative support of this thesis with the lectures given by her.

More thanks are for Çağrı ÇİFTELER (City Planner) and Himmet HOYBAT (Project research assistant in Fatih University) and Dr. Onur UZONUR (Nuclear Engineer in ÇNAEM) for their technical supports in preparation of the thesis.

I would like to thank my parents for their love, patience, and encouragement.

I also would like to thank, Dr. Mustafa ÖZTÜRK and Assist. Prof Dr. Ender BOYAR , Prof. Dr. Gülen GÜLLÜ (For her precious contributions in air pollution work of Turkey), Dr. Ali Sait GÜLLÜ, Mehmet ŞAHİN (Muğla İl Çevre ve Orman Müdürlüğü Bakan Müşaviri, Müdür Vekili) and Ercan KÖSEOĞLU (Muğla İl Çevre ve Orman Müdürlüğü, Çevre Yönetimi Şube Müdür Vekili) for their precious and kind helps in this thesis work.

# TABLE OF CONTENTS

# LIST OF TABLES

**TABLE**

# LIST OF FIGURES

**FIGURE**

# LIST OF SYSMBOLS AND ABBREVIATIONS

**SYMBOLS/ABBREVATIONS**

| | |
|---|---|
| AAAR | American Association of Aerosol Research |
| GARD | Global Alliance Against Chronic Respiratory Diseases |
| VOC | Volatile Organic Compound |
| EPA | Environmental Protection Agency |
| ICD-10 | International Statistical Classification of Diseases and Related Health Problems 10th Revision |
| NGOs | Universities and Non-Governmental Organizations |
| OAQPS | The EPA Office of Air Quality Planning and Standards |
| AQI | Air Quality Index |
| API | Air Pollution Index |
| PSI | Pollutant Standard Index |
| PM | Particulate Matter |
| $PM_{10}$ | Combination of Coarse and Fine Particulate Matter |
| $PM_{2.5}$ | Fine Particulate Matter |
| $SO_2$ | Sulfur dioxide |
| $O_3$ | Ozone |
| CO | Carbon Monoxide |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| NOx | Nitric oxide and Nitrogen dioxide |
| $SO_x$ | Sulfur Oxides |
| VOC | Volatile Organic Compounds |
| NAAQS | National Ambient Air Quality Standards |
| $O_2$ | Oxygen |
| OH | Hydroxyl radical |

| | |
|---|---|
| GPS | Global Positioning System |
| GIS | Geography Information System |
| VPN | Virtual Private Network |
| COPD | Chronic Obstructive Pulmonary Disease |
| AIDS | Acquired Immunodeficiency syndrome |
| CRD | Chronic Respiratory Disease |
| CAD | Chronic Airway Diseases |
| HIV | Human Immunodeficiency Virus |
| AQMNC | Air Quality Monitoring Network Center |
| MDG | Millennium Development Goal |
| NCD | Non Communicable Disease |
| NCDnet | Global Noncommunicable Disease Network |
| NGO | Non-governmental organization |
| V/Q | Ventilation/Perfusion |
| TB | Tuberculosis |
| PAH | Polycyclic Aromatic Hydrocarbon |
| UN | United Nations |
| EU | European Union |
| USA | United States of America |
| WHO | World Health Organization |

# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND

The problems and solutions discussed in this thesis requires the management of an environmental scientist that should have all capabilities, knowledge, skills and capacities of making scientific research, following technological innovations and to be informed with and involved in governmental policies and effective with decision and policy makers.

In March 2010, the American Association of Aerosol Research (AAAR) held a conference titled “Air Pollution and Health: Bridging the Gap from Sources to Health Outcomes,” which was sponsored by the U.S. EPA and the Health Effects Institute. This conference brought together more than 500 scientists from across the air pollution disciplines, along with risk assessors and policy makers, to look at air pollution through new perspectives. The conference was designed to help disseminate and integrate results from scientific studies that cut across the range of air pollution– and health-related disciplines of the source-to-health effects continuum. The conference addressed the science of air pollution and health within a multi pollutant framework, focusing on five key science areas—sources, atmospheric sciences, exposure, dose, and health effect. Eight key policy-relevant science questions that integrated across various parts of these science areas formed the basis of the meeting, and a ninth question addressed the policy implications of the findings.

In this thesis work we have done a research in urge of answering the above mentioned questions addressed in reference titled “Air pollution and health: bridging the gap from sources to health outcomes.” [1].

Dated 11.11.2010 and No. 602-24509 Muğla Governorship Approval Authority as a Chemical Engineer with the Provincial Environment and Forestry Directorate, on

GARD (Global Alliance Against Chronic Respiratory Diseases) Turkey (CAD) Chronic Airway Diseases was given to me. I am in charge due to the Provincial Executive Committee for the Prevention and Control Program to reason start up this thesis. To our knowledge there exists no thesis related with deep health issues exist until now related with Muğla city with our motivation and viewpoints. See: http://tez2.yok.gov.tr/.

Unfortunately during the thesis work there occurred some unwanted and unambiguous consequences of the work that will be a part of answers to the above questions; I have been withdrawn from my position in GARD Muğla (03.11.2011) without any reason, but still with some evidence based work will be discussed in Chapter 4, Results and Discussions with reference figure 4.28 as evidence.

This thesis is a case work about air “criteria pollutants” and health indicators to bridge the gap from sources to health outcomes in Muğla city. No expert or heuristic system, no statistical or mathematical evaluations, models or simulations could have done what an expert eye has done for this case. Machines can learn but they need a real expert to teach them. In this respect the huge raw data (health and air quality data, from Muğla, Yatağan Air Quality Monitoring Network Centers (AQMNC)) with all supportive materials and methods by a near expert eye still in learning process is evaluated to open a new era in GARD work [1, 2].

## 1.2 PURPOSE OF STUDY

This thesis aims the evaluation of air criteria pollutants ($SO_2$ and $PM_{10}$), air pollution and Global Alliance against chronic Respiratory Diseases (GARD) work on the above mentioned background issues and motivations in Muğla city. In this thesis the data of GARD in Muğla city will be evaluated from the academical perspective to fullfill and bridge the gaps between the data available with the health outcomes based on scenarios and policies for Muğla.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 AIR POLLUTION AND CRITERIA AIR POLLUTANTS STANDARDS, LEGISLATIONS

In this thesis the evaluation of air pollution will be health of population centered. Air pollution can have both acute and chronic health effects latter is cumulative and progressive. In this cumulative and progressive, chronic affect respect the literature will be evaluated with special emphasis for the studies of populations residing near point sources of air pollution.

Residential proximity to point sources of air pollution is a potential source of exposure to chemicals with various health impacts and known or suspected carcinogens. Fossil fuel-fired (i.e., coal, oil, natural gas) electrical power plants emit known or suspected carcinogens, including metals such as chromium and nickel, radionuclides such as radon and uranium, and PAH such as benzo[a]pyrene. Nonferrous metal smelters emit inorganic arsenic and other metals and $SO_2$ [2, 3]. Investigation of the etiologic mechanisms that might underlie air pollution's role in lung cancer occurrence, including its role in the association of lung cancer with preexisting respiratory disease led to the risk of lung cancer is increased among people with preexisting lung disease (e.g., chronic obstructive pulmonary disease and asthma) and among those who have exhibited accelerated rates of decline in pulmonary function. Long-term exposure to air pollution has also been associated with low levels of lung function and chronic respiratory symptoms in several cross-sectional and longitudinal studies of children. These reported associations suggest mechanisms other than, or in addition to, the direct initiation or promotion of lung tumors, by which prolonged exposure to air pollution could increase lung cancer risk [2, 3].

**Table 2.1** Selected known carcinogens in ambient air [3].

| Substance | Urban air | Rural air |
|---|---|---|
| **Inorganic particulates (ng/m$^3$)** | | |
| **Arsenic** | 2-130 | <0.5-5 |
| **Asbestos** | 10-100 | - |
| **Chromium** | 5-120 | <1-10 |
| **Nickel** | 10-1000 | <10 |
| **Radionuclides (Ci/m$^3$)** | | |
| **$^{210}$Pb** | $1x10^{-15}$-$30x10^{-15}$ | $5.5x10^{-15}$-$10x10^{-15}$ |
| **$^{212}$Pb** | $0.1x10^{-15}$-$4x10^{-15}$ | $0.03x10^{-15}$-$0.06x10^{-15}$ |
| **$^{222}$Rn** | $20x10^{-125}$-$1.000x10^{-12}$ | $0.1x10^{-12}$-$20x10^{-12}$ |
| **Gaseous and particulate organic species (ng/m$^3$)** | | |
| **Benzene** | 5-90 | - |
| **Benzo(a)pyrene** | 1-50 | - |
| **Benzene-soluble organics** | 1.000-2.000 | 200-300 |

Pollutants can be classified primary and secondary. Primary pollutants are substances directly emitted from a process. See: http://apollo.lsc.vsc.edu/classes/met130/notes/chapter18/primary.html.

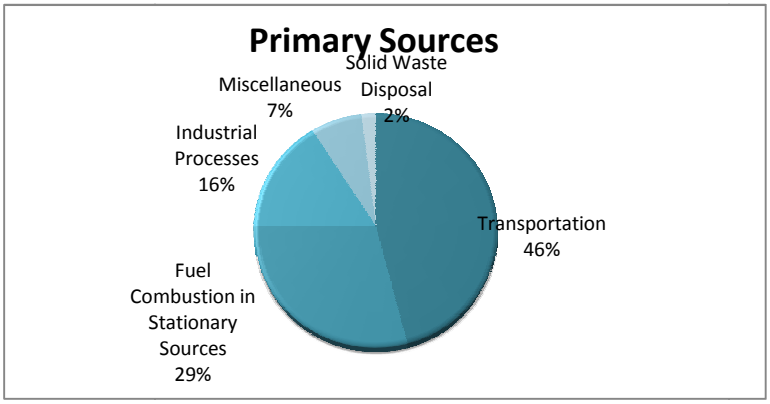



**Figure 2.1** Primary sources for air pollutants.

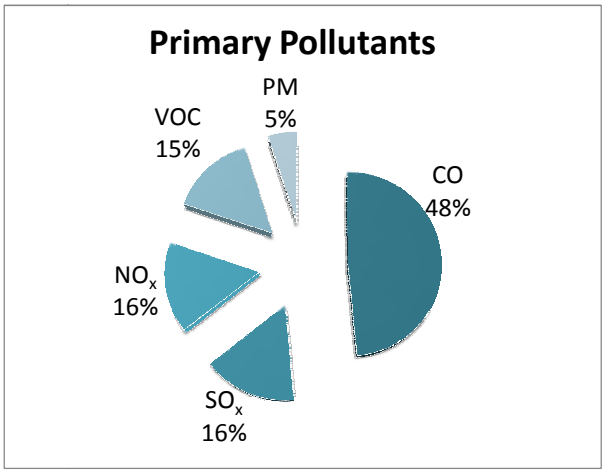



**Figure 2.2** Primary air pollutants.

Primary pollutants are

- Carbon monoxide (CO): odorless, colorless, poisonous gas, created by incomplete combustion (especially bad with older cars), generates headaches, drowsiness, fatigue, can result in death.
- Nitrogen oxides (NOx): emitted directly by autos, industry.
- Sulfur Oxides (SOx): $SO_2$ - sulfur dioxide, produced largely through coal burning, responsible for acid rain problem.
- Volatile organic compounds (VOC's): highly reactive organic compounds, release through incomplete combustion and industrial sources.
- Particulate Matter (PM): bad for lungs and respiratory system.

(See: http://apollo.lsc.vsc.edu/classes/met130/notes/chapter18/primary.html) [4].

Secondary pollutants occur as a result of a reaction of primary pollutants. These are not emitted directly to the air, water, or soil.

The best known of the secondary pollutants are nitrogen dioxide, ozone, hydrogen peroxide, aldehydes etc. (See: http://science.jrank.org/pages/6028/Secondary-Pollutants.html), [5].

Photochemical oxidants

- Photochemical oxidants: products of secondary atmospheric reactions driven by solar energy.
- One of the most important reactions involves formation of singlet (atomic) oxygen by splitting nitrogen dioxide ($NO_2$).
- Then the atomic oxygen reacts with another molecule of $O_2$ to make ozone ($O_3$).
- Ozone formed in the stratosphere provides a valuable shield for the biosphere by absorbing incoming ultraviolet radiation.
- In ambient air, however, $O_3$ is a strong oxidizing reagent and damages vegetation, building materials, and sensitive tissues.

See: http://zoology.muohio.edu/oris/cunn06/cs6_18.htm

Atmospheric oxidant production:

1. $NO + VOC \longrightarrow NO_2$
2. $NO_2 + UV \longrightarrow NO + O$
3. $O + O_2 \longrightarrow O_3$
4. $NO_2 + VOC \longrightarrow$ PAN, etc. (peroxyacetyl nitrate)

Net results:

$NO + VOC + O_2 + UV \longrightarrow O_3$, PAN, and other oxidants

**Figure 2.3** Secondary athmospheric oxidant productions by photochemical reactions**.**

### 2.1.1 Air Quality Standards and Regulations

The Air Quality Index (AQI) (also known as the Air Pollution Index (API) or Pollutant Standard Index (PSI) is a number used by government agencies to characterize the quality of the air at a given location.

See: http://en.wikipedia.org/wiki/Air_Quality_Index#Limitations_of_the_AQI.

### 2.1.2 API Mechanics

An individual score is assigned to the level of each pollutant and the final API is the highest of those 5 scores. The pollutants can be measured quite differently. $SO_2$, $NO_2$ and $PM_{10}$ concentrations are measured as average per day. CO and $O_3$ are more harmful and are measured as average per hour. The final API value is calculated per day.

The scale for each pollutant is non-linear, as is the final API score. Thus an API of 100 does not mean twice the pollution of API at 50, nor does it mean twice as harmful. While an API of 50 from day 1 to 182 and API of 100 from day 183 to 365 does provide an annual average of 75, it does *not* mean the pollution is acceptable even if the benchmark of 100 is deemed safe. This is because the benchmark is a 24 hour target. The annual average must match against the annual target. It is entirely possible to have safe air every day of the year but still fail the annual pollution benchmark.

**Table 2.2** API and health implications indicating daily targets, with related colored air pollution levels as a sample work. See: http://en.wikipedia.org/wiki/Air_Quality_Index#Limitations_of_the_AQI for further references.

| API | Air Pollution Level | Health Implications |
|---|---|---|
| 0 - 50 | Excellent | No health implications |
| 51 -100 | Good | No health implications |
| 101-150 | Slightly Polluted | Slight irritations may occur, individuals with breathing or heart problems should reduce outdoor exercise. |
| 151-200 | Lightly Polluted | Slight irritations may occur, individuals with breathing or heart problems should reduce outdoor exercise. |
| 201-250 | Moderately Polluted | Healthy people will be noticeably affected. People with breathing or heart problems will experience reduced endurance in activities. These individuals and elders should remain indoors and restrict activities. |
| 251-300 | Heavily Polluted | Healthy people will be noticeably affected. People with breathing or heart problems will experience reduced endurance in activities. These individuals and elders should remain indoors and restrict activities. |
| 300+ | Severely Polluted | Healthy people will experience reduced endurance in activities. There may be strong irritations and symptoms and may trigger other illnesses. Elders and the sick should remain indoors and avoid exercise. Healthy individuals should avoid out door activities. |

| | SO2 | NO2 | CO | O3 | PM10 |
|---|---|---|---|---|---|
| Hava Kalitesi İndeksi | 1 saatlik ortalama | 24 saatlik ortalama | 24 saatlik ortalama | 1 saatlik ortalama | 24 saatlik ortalama |
| | [µg/m³] | [µg/m³] | [mg/m³] | [µg/m³] | [µg/m³] |
| 1 (çok iyi) | 0 -50 | 0 - 45 | 0 – 2,9 | 0 - 35 | 0 - 55 |
| 2 (iyi) | 51-199 | 46 - 89 | 3,0 – 8,9 | 36 - 89 | 56-109 |
| 3 (yeterli) | 200-399 | 90 - 179 | 9,0 – 15,9 | 90 - 179 | 110-159 |
| 4 (orta) | 400-899 | 180 - 299 | 16 – 21,9 | 180 - 239 | 160-219 |
| 5 (kötü) | 900-1499 | 300- 699 | 22,0 - 49,9 | 240 - 359 | 220-799 |
| 6 (çok kötü) | >1500 | > 700 | > 50,0 | > 360 | > 800 |

**Figure 2.4** Air quality index/Air pollution index as accepted by Turkish authorities (See: http://www.havaizleme.gov.tr/Default.ltr.aspx).

The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to

public health and the environment. The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards for six principal pollutants are listed in Table 2.3 without any distortion of the original material. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb - 1 part in 1.000.000.000) by volume, milligrams per cubic meter of air ($mg/m^3$), and micrograms per cubic meter of air ($\mu g/m^3$) [5-9].

**Table 2.3** Ambient Air Quality EPA Standards.

| | **Primary Standards** | | **Secondary Standards** | |
|---|---|---|---|---|
| **Pollutant** | **Level** | **Averaging Time** | **Level** | **Averaging Time** |
| **Carbon Monoxide** | 9 ppm (10 $mg/m^3$) | 8-hour (1) | None | |
| | 35 ppm (40 $mg/m^3$) | 1-hour (1) | | |
| **Lead** | 0.15 $\mu g/m^3$ (2) | Rolling 3-Month Average | Same as Primary | |
| **Nitrogen Dioxide** | 53 ppb (3) | Annual (Arithmetic Average) | Same as Primary | |
| | 100 ppb | 1-hour (4) | None | |
| **Particulate Matter ($PM_{10}$)** | 150 $\mu g/m^3$ | 24-hour (5) | Same as Primary | |
| **Particulate Matter ($PM_{2.5}$)** | 15.0 $\mu g/m^3$ | Annual (Arithmetic Average) (6) | Same as Primary | |
| | 35 $\mu g/m^3$ | 24-hour (7) | Same as Primary | |
| **Ozone** | 0.075 ppm (2008 std) | 8-hour (8) | Same as Primary | |
| | 0.08 ppm (1997 std) | 8-hour (9) | Same as Primary | |
| | 0.12 ppm | 1-hour (10) | Same as Primary | |
| **Sulfur Dioxide** | 0.03 ppm | Annual (Arithmetic Average) | 0.5 ppm | 3-hour (1) |
| | 0.14 ppm | 24-hour (1) | | |
| | 75 ppb (11) | 1-hour | None | |

(1) Not to be exceeded more than once per year.

(2)Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(3) The official level of the annual $NO_2$ standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).
(5) Not to be exceeded more than once per year on average over 3 years.
(6) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.
(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).
(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)
(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.
(c) EPA is in the process of reconsidering these standards (set in March 2008).
(10) (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").
(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is < 1.
(11) (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.
The U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for six principal air pollutants “criteria pollutants”: carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), particulate matter (PM) in two size ranges [< 2.5 µm ($PM_{2.5}$) and < 10 µm ($PM_{10}$)], ozone ($O_3$), and sulfur dioxide ($SO_2$).

### 2.1.3 EU Standards and Regulations

Tthe European Union has also developed an extensive body of legislation which establishes health based standards and objectives for a number of pollutants in air. These standards and objectives are given as it is originally in the Table 2.4. These apply over differing periods of time because the observed health impacts associated with the various pollutants occur over different exposure times. See: http://ec.europa.eu/environment/air/quality/standards.htm, [5-9].

**Table 2.4** Ambient Air Quality EU Standards.

| Pollutant | Concentration | Averaging period | Legal nature | Permitted exceedences each year |
|---|---|---|---|---|
| **Fine articles (PM2.5)** | 25 µg/m3*** | 1 year | Target value enters into force 1.1.2010<br>Limit value enters into force 1.1.2015 | n/a |
| **Sulphur dioxide (SO2)** | 350 µg/m3 | 1 hour | Limit value enters into force 1.1.2005 | 24 |
| | 125 µg/m3 | 24 hours | Limit value enters into force 1.1.2005 | 3 |
| **Nitrogen dioxide (NO2)** | 200 µg/m3 | 1 hour | Limit value enters into force 1.1.2010 | 18 |
| | 40 µg/m3 | 1 year | Limit value enters into force 1.1.2010* | n/a |
| **PM10** | 50 µg/m3 | 24 hours | Limit value enters into force 1.1.2005** | 35 |
| | 40 µg/m3 | 1 year | Limit value enters into force 1.1.2005** | n/a |
| **Lead (Pb)** | 0.5 µg/m3 | 1 year | Limit value enters into force 1.1.2005 (or 1.1.2010 in the immediate vicinity of specific, notified industrial sources; and a 1.0 µg/m3 limit value applies from 1.1.2005 to 31.12.2009) | n/a |
| **Carbon Monoxide (CO)** | 10 mg/m3 | Maximum daily 8 hour mean | Limit value enters into force 1.1.2005 | n/a |
| **Benzene** | 5 µg/m3 | 1 year | Limit value enters into force 1.1.2010** | n/a |
| **Ozone** | 120 µg/m3 | Maximum daily 8 hour mean | Target value enters into force 1.1.2010 | 25 days averaged over 3 years |
| **Arsenic (As)** | 6 ng/m3 | 1 year | Target value enters into force 1.1.2012 | n/a |
| **Cadmium (Cd)** | 5 ng/m3 | 1 year | Target value enters into force 1.1.2012 | n/a |
| **Nickel (Ni)** | 20 ng/m3 | 1 year | Target value enters into force 1.1.2012 | n/a |
| **Polycyclic Aromatic Hydrocarbons** | 1 ng/m3 (expressed as concentration of Benzo(a)pyrene) | 1 year | Target value enters into force 1.1.2012 | n/a |

**Under the new Directive the member State can apply for an extension of up to five years (i.e. maximum up to 2015) in a specific zone. Request is subject to assessment by the Commission. . In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (* 48 µg/m3 for annual NO2 limit value).

***Under the new Directive the Member State can apply for an extension until three years after the date of entry into force of the new Directive (i.e. May 2011) in a specific zone. Request is subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (35 days at 75*µg/m3 for daily PM10 limit value, 48 µg/m3 for annual Pm10 limit value).

****Standard introduced by the new Directive.*

*Under EU law a limit value is legally binding from the date it enters into force subject to any exceedances permitted by the legislation. A target value is to be attained as far as possible by the attainment date and so is less strict than a limit value.*

The new Directive is introducing additional PM2.5 objectives targetting the **exposure** of the population to fine particles. These objectives are set at the national level and are based on the average exposure indicator (AEI).

AEI is determined as a 3-year running annual mean PM2.5 concentration averaged over the selected monitoring stations in agglomerations and larger urban areas, set in urban background locations to best assess the PM2.5 exposure to the general population.

| *Title* | *Metric* | *Averaging period* | *Legal nature* | *Permitted exceedences each year* |
|---|---|---|---|---|
| PM2.5 Exposure concentration obligation | 20 µg/m3 (AEI) | Based on 3 year average | Legally binding in 2015 (years 2013,2014,2015) | n/a |
| PM2.5 Exposure reduction target | Percentage reduction* + all measures to reach 18 µg/m3 (AEI) | Based on 3 year average | Reduction to be attained where possible in 2020, determined on the basis of the value of exposure indicator in 2010 | n/a |

** Depending on the value of AEI in 2010, a percentage reduction requirement ( 0,10,15, or 20%) is set in the Directive. If AEI in 2010 is assessed to be over 22 µg/m3, all appropriate measures need to be taken to achieve 18 µg/m3 by 2020.*

### 2.1.4 "Particulate Matter" $PM_{10}$

"Particulate Matter," also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles [6-9].

The size of particles is directly linked to their potential for causing health problems (Figure 2.5). EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.

- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.

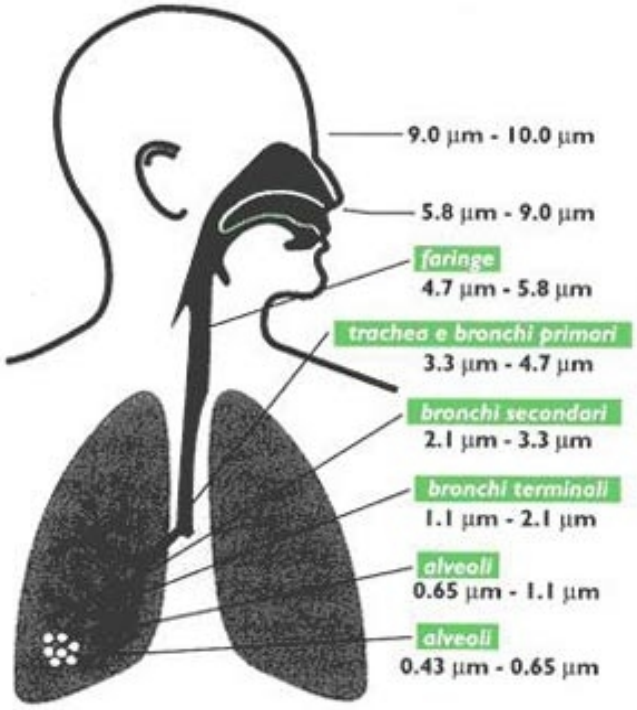



**Figure 2.5** The comparative sizes for varios particulate matter in respiratory system.

Non-mortality effects of $PM_{10}$ are covered under two categories: chronic obstructive pulmonary diseases (COPD), and respiratory admissions to hospital.

The incidence of $PM_{10}$ pollution also affects a number of chronic obstructive pulmonary diseases and allied conditions [6-9]. These include:

• bronchitis
• chronic bronchitis
• emphysema
• bronchiectasis
• extrinsic allegoric alveolitis
• chronic airways obstruction.

### 2.1.5 Sulfur Dioxide $SO_2$

($SO_2$) is one of a group of highly reactive gases known as “oxides of sulfur”. The largest sources of $SO_2$ emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of $SO_2$ emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur

containing fuels by locomotives, large ships, and non-road equipment. $SO_2$ is linked with a number of adverse effects on the respiratory system.

Sulphur dioxide ($SO_2$) is a pungent gas that causes sore throat and eyes, and can have an effect on mortality. Sulphur oxides (primarily $SO_2$ and lesser quantities of sulphur trioxide) are gases formed by the oxidation of sulphur contaminants in fuel on combustion. $SO_2$ is a potent respiratory irritant, and has been associated with increased hospital admissions for respiratory and cardiovascular disease, as well as mortality. Asthmatics are a particularly susceptible group [7, 8].

## 2.2 CHRONIC RESPIRATORY DISEASES

Exposure and genetic predisposition should be assessed together to fill the gaps between exposure to air pollution and the expected health outcomes (Figures 2.6, 2.7). Table 2.5 lists examples of environmentally caused diseases. The two most important determinants in one's risk of developing an environmental disease are: a. exposure; and b. one's unique genetic make-up, usually neglected because of economic and lack of knowledge and practice. The first six examples in Table 2.5 represent large doses of an environmental agent that can be quite easily documented by a good medical history e.g. pack-years of smoking. The next three examples represent exposures to sun and to the outdoors and chemicals in the work place; quantitation in these cases is generally more difficult than the first six examples e.g.what is the actual number of days worked? Was the exposure identical for all of these days? The last four examples of Table 2.5 depict even more blurred cases in which a cause-and-effect correlation might be demonstrated by large human populations, but a cause-and-effect in a particular individual is often difficult to prove medically [6-12].

Figure 6 summarizes the whole pollution exposure related biomarker assessment levels to relate with any kind of pollutant exposure and health related issue. In this respect evaluation of air pollution and ambient air criteria pollutants and their health effects on various levels of health indicators: tissue, systemic, organism, population, community can be done [10-11].

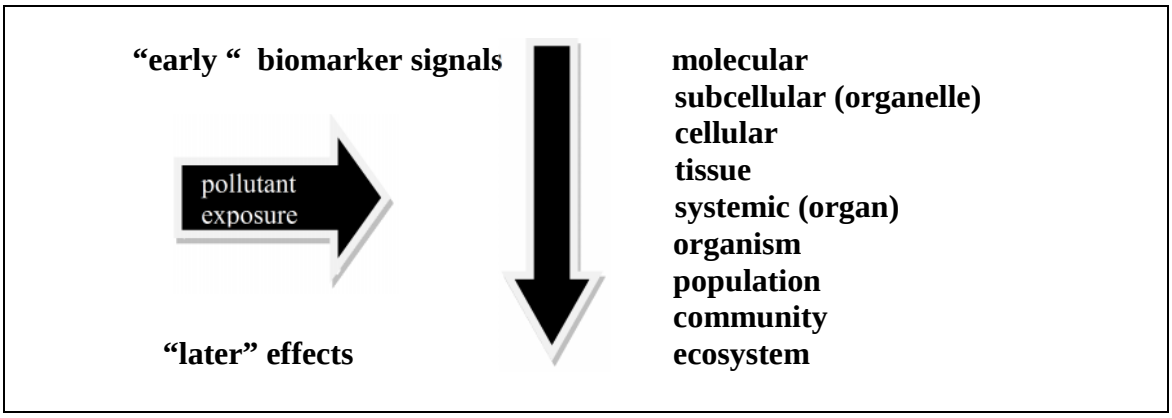



**Figure 2.6** Schematic representation of the sequential order of responses to pollutant stress within a biological system [10, 11].

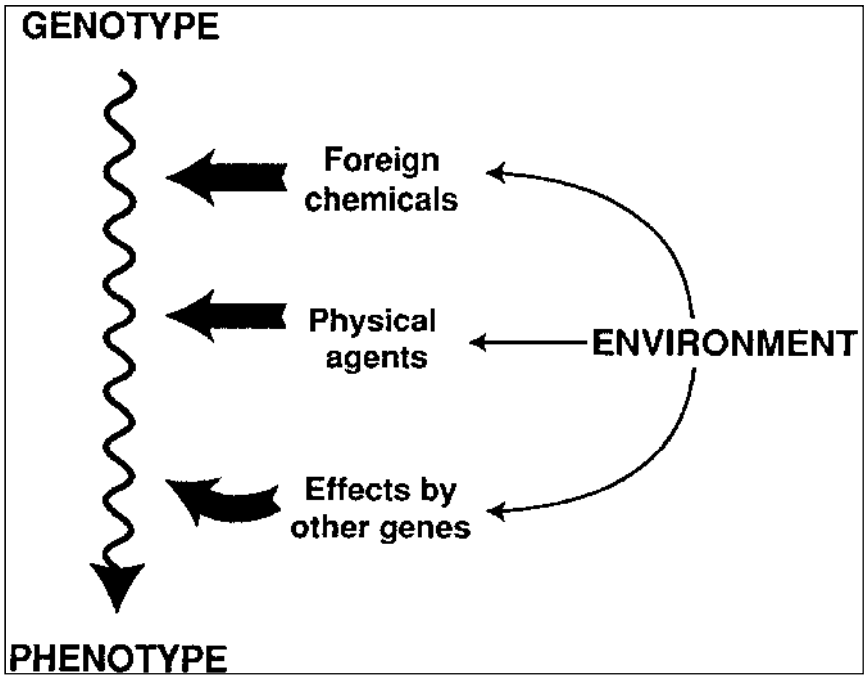



**Figure 2.7** Environmental and epigenetic effects on an organism's genotype, by which the phenotype can be changed [11].

**Table 2.5 Environmentally caused disease examples [11].**

| | |
|---|---|
| 1. | **Bronchogenic carcinoma in cigarette smokers** |
| 2. | **Chronic bronchitis, emphysema, heavy wrinkles in cigarette smokers** |
| 3. | **Liver fibrosis, cirrhosis in alcoholics** |
| 4. | **Drug-related lupus syndrome in patients taking procainamide** |
| 5. | **Dangerously lowered blood pressure in patients taking debrisoquine or sparteine** |
| 6. | **Lung cancer in people exposed to radon** |
| 7. | **Malignant melanoma, other skin cancers, heat stroke, sunburn in persons exposed to excessive sunlight** |
| 8. | **Lung cancer in uranium mine workers** |
| 9. | **Chloracne, porphyria cutanea tarda in workers exposed to dioxin and other halogenated hydrocarbons** |
| 10. | **Ataxia, lowered mentality in persons exposed to high levels of lead** |
| 11. | **Increased risk of chronic myelogenous leukemia in workers exposed to benzene, of urinary bladder cancer in chemical dye workers** |
| 12. | **Asthma in children and adults exposed to indoor or outdoor air pollution** |
| 13. | **Toxicity or malignancy in persons living near a hazardous toxic waste dump site** |

Chronic respiratory diseases (CRDs) are firmly on the political and health-care agendas of the WHO 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases (NCD Action Plan), and that GARD is also in line with this plan. The Millennium Development Goals (MDGs) focused on maternal and perinatal conditions such as HIV/AIDS, tuberculosis (TB), malaria and other infectious diseases. However, in the next decade, the push will be to prioritize noncommunicable diseases (NCDs), making chronic disease the most important [12].

The Global Noncommunicable Disease Network (NCDnet) is a new network to combat NCDs in developing countries. Its goals are to raise awareness through advocacy, increase resource availability and catalyse country-level implementation [12].

The 193 Member States of WHO have been surveyed and analysed. The data collected has lead to the first Global Status Report on NCDs that is released in early 2011 [12].

Aligning the GARD 2008–2013 Work Plan with the WHO 2008–2013 Action Plan for the Global Strategy for thePrevention and Control of Noncommunicable

Diseases (NCD Action Plan) is an important strategy of the works mentioned in the thesis [2-12].

### 2.2.1 Chronic Respiratory Diseases Worldwide

Map in Figure 2.8 shows the age-standardized estimate of mortality by chronic respiratory diseases per 100.000 people.

Chronic respiratory diseases are chronic diseases of the airways and other structures of the lung. Some of the most common are asthma, chronic obstructive pulmonary disease (COPD), respiratory allergies, occupational lung diseases and pulmonary hypertension.

Chronic respiratory diseases were responsible for 4.2 million deaths globally in 2008 and are on the increase. There is a great need for more and better care of these diseases [9, 13].

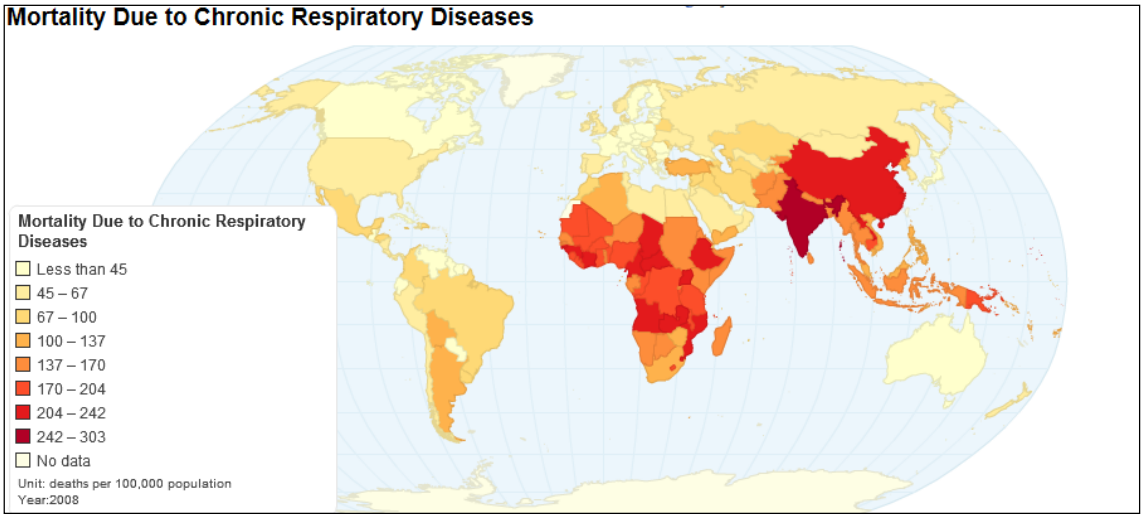



**Figure 2.8** Mortality due to Chronic Respiratory Disases See: http://chartsbin.com/view/3754

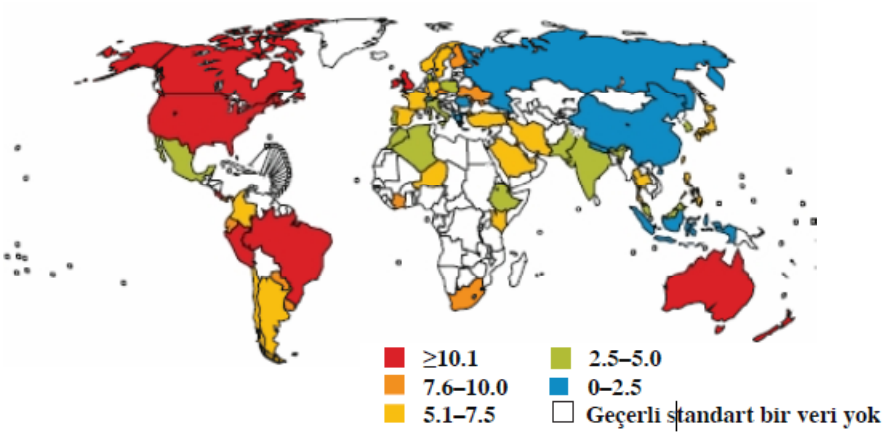



**Figure 2.9** Asthma prevalence world map [14].

For cases in which chronic airways disease is suspected, a complete medical history should be taken and physical and laboratory examinations performed. There are several key points that need to be evaluated during this process such as characterizing the problem. Cough, wheeze, breathlessness, shortness of breath, chest tightness, watery runny nose, and itchy nose (including exercise-related symptoms) are common symptoms of chronic airways diseases among patients presenting in general practice. Once a presentation consistent with airways disease has been established, further characterize the problem in the following three ways:

- Establish Chronicity
- Exclude Non-Respiratory or Other Causes
- Exclude Infectious Diseases

### 2.2.2 Chronic Respiratory Disases in Turkey

In Turkey, chronic diseases accounted for 79 % of all deaths in 2002 (Figure 2.10) that is 437.000. Total deaths related to chronic disease in Turkey in 2002 is 346.000 and chronic respiratory diseases make up 6% of these.

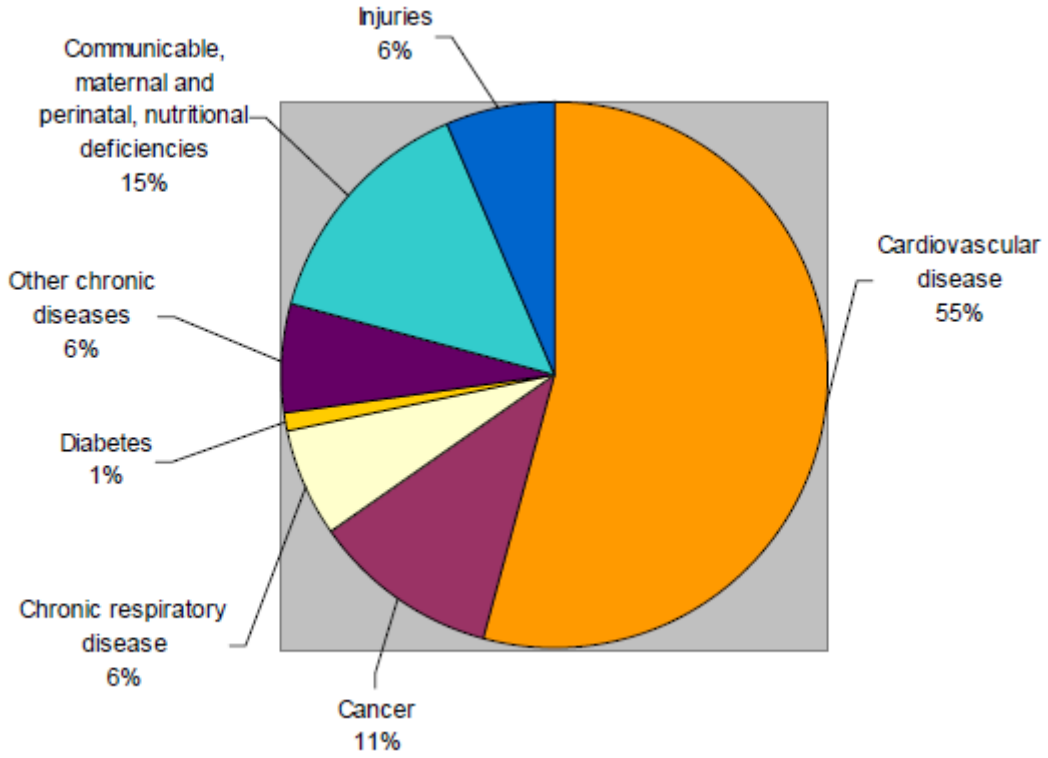



**Figure 2.10** Deaths by cause in 2002 in Turkey.
See: http://www.who.int/chp/chronic_disease_report/turkey.pdf

#### *2.2.2.1 Asthma*

Asthma is the common chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction, and bronchospasm. Many environmental risk factors have been associated with asthma development and morbidity in children.

Maternal tobacco smoking during pregnancy and after delivery is associated with a greater risk of asthma-like symptoms, wheezing, and respiratory infections during childhood. Low air quality, from traffic pollution or high ozone levels, has been repeatedly associated with increased asthma morbidity and has a suggested association with asthma development that needs further research.

Recent studies show a relationship between exposure to air pollutants (e.g. from traffic) and childhood asthma. This research finds that both the occurrence of the disease and exacerbation of childhood asthma are affected by outdoor air pollutants. High levels of endotoxin exposure may contribute to asthma risk. As of 2009, 300 million people worldwide were affected by asthma leading to approximately 250.000

deaths per year. It is estimated that asthma has a 7-10 % prevalence worldwide. As of 1998, there was a great disparity in prevalence worldwide across the world (as high as a 20 to 60-fold difference), with a trend toward more developed and westernized countries having higher rates of asthma. Westernization however does not explain the entire difference in asthma prevalence between countries, and the disparities may also be affected by differences in genetic, social and environmental risk factors. See: http://en.wikipedia.org/wiki/Asthma.

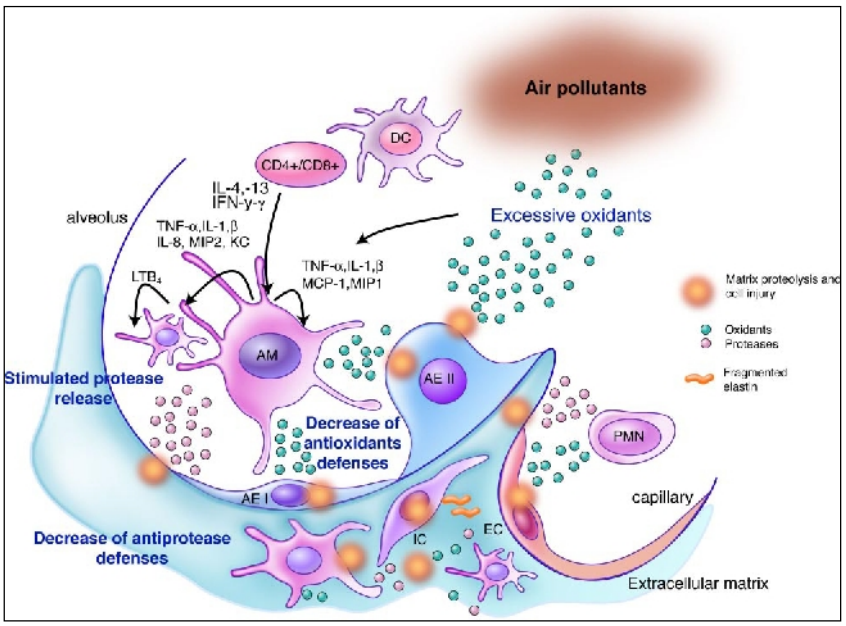



**Figure 2.11** Inflammation, extracellular matrix proteolysis, and oxidative stress: the classical hypothesis. Air pollutants, including cigarette smoke, are a rich source of oxidants (i.e., O2–, NO), leading to the recruitment of macrophages and neutrophils with a series of complex mechanisms [15].

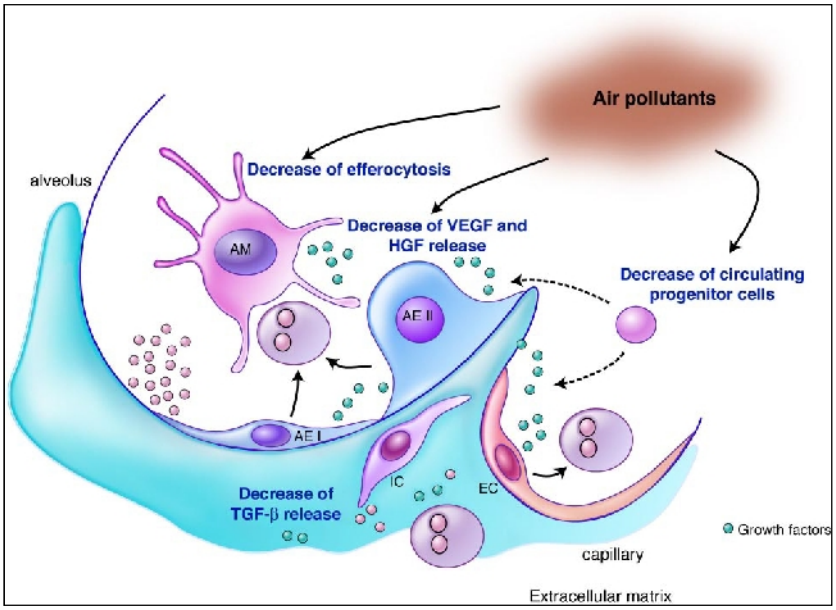



**Figure 2.12** Breakdown of cellular and molecular maintenance program in emphysema. Air pollutants, including cigarette smoke, might inhibit the production and release of growth and survival factors from alveolar epithelial cells, endothelial cells, and interstitiitial cells resulting in apoptosis [15].

### *2.2.2.2 Chronic Obstructive Pulmonary Disease (COPD)*

Chronic obstructive pulmonary diseases (COPD) are comprised of pulmonary emphysema, chronic bronchitis, and structural and inflammatory changes of small airways, is a leading cause of morbidity and mortality in the world. A better understanding of the pathobiology of COPD is critical for the developing of novel therapies, as the majority of patients with the disease have little therapeutic options at the present time. The pathobiology of COPD encompasses multiple injurious processes including inflammation (excessive or inappropriate innate and adaptive immunity), cellular apoptosis, altered cellular and molecular alveolar maintenance program, abnormal cell repair, extracellular matrix destruction (protease and anti-protease imbalance), and oxidative stress (oxidant and antioxidant imbalance). These processes are triggered by urban and rural air pollutants and active and/or passive cigarette smoke and modified by cellular senescence and infection. A series of receptor-mediated signal transduction pathways are activated by reactive oxygen species and tobacco components, resulting in impairment of a variety of cell signaling and cytokine networks, subsequently leading to chronic airway responses with mucus production, airway remodeling, and alveolar destruction. The authors Toshinori Yoshida and Rubin

M. Tuder provide an updated insight into the molecular and cellular pathobiology of COPD based on human and/or animal data [15].

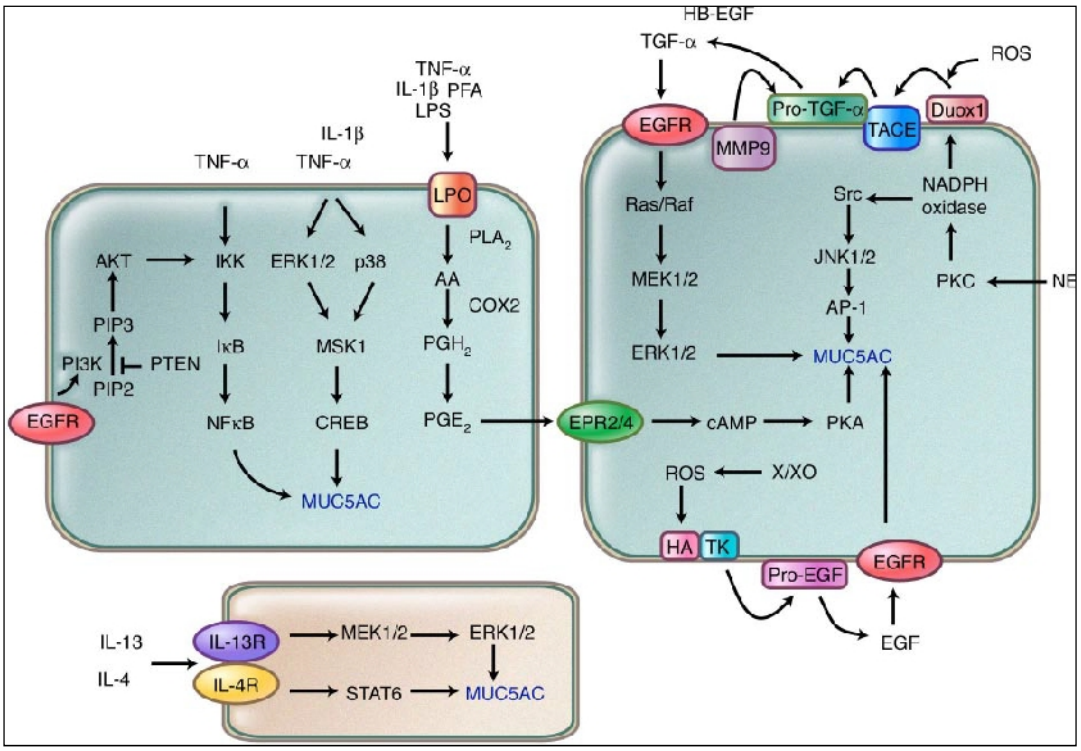



**Figure 2.13** Oxidative stress responses in chronic obstructive pulmonary disease (COPD). Oxidative stress has a central role in the pathogenesis of COPD as oxidants mediate inflammation, extracellular degradation, and failure of alveolar maintenance [15].

Chronic obstructive pulmonary disease (COPD) is also known as chronic obstructive lung disease (COLD) is the co-occurrence of chronic bronchitis and emphysema, a pair of commonly co-existing diseases of the lungs in which the airways become narrowed. It is a progressive disease that makes it hard to breathe. "Progressive" means the disease gets worse over time. COPD can cause coughing that produces large amounts of mucus, wheezing, shortness of breath, chest tightness, and other symptoms. Cigarette smoking is the leading cause of COPD. Most people who have COPD smoke or used to smoke. Long-term exposure to other lung irritants, such as air pollution, chemical fumes, or dust, also may contribute to COPD. To understand COPD, it helps to understand how the lungs work. The air that you breathe goes down the windpipe into tubes in lungs called bronchial tubes or airways. Within the lungs, bronchial tubes branch into thousands of smaller, thinner tubes called bronchioles.

These tubes end in bunches of tiny round air sacs called alveoli. Small blood vessels called capillaries run through the walls of the air sacs. When air reaches the air sacs, the oxygen in the air passes through the air sac walls into the blood in the capillaries. At the same time, carbon dioxide moves from the capillaries into the air sacs. This process is called gas exchange. The airways and air sacs are elastic. In COPD, less air flows in and out of the airways because of one or more of the following:

- The airways and air sacs lose their elastic quality.
- The walls between many of the air sacs are destroyed.
- The walls of the airways become thick and inflamed.
- The airways make more mucus than usual, which tends to clog them.

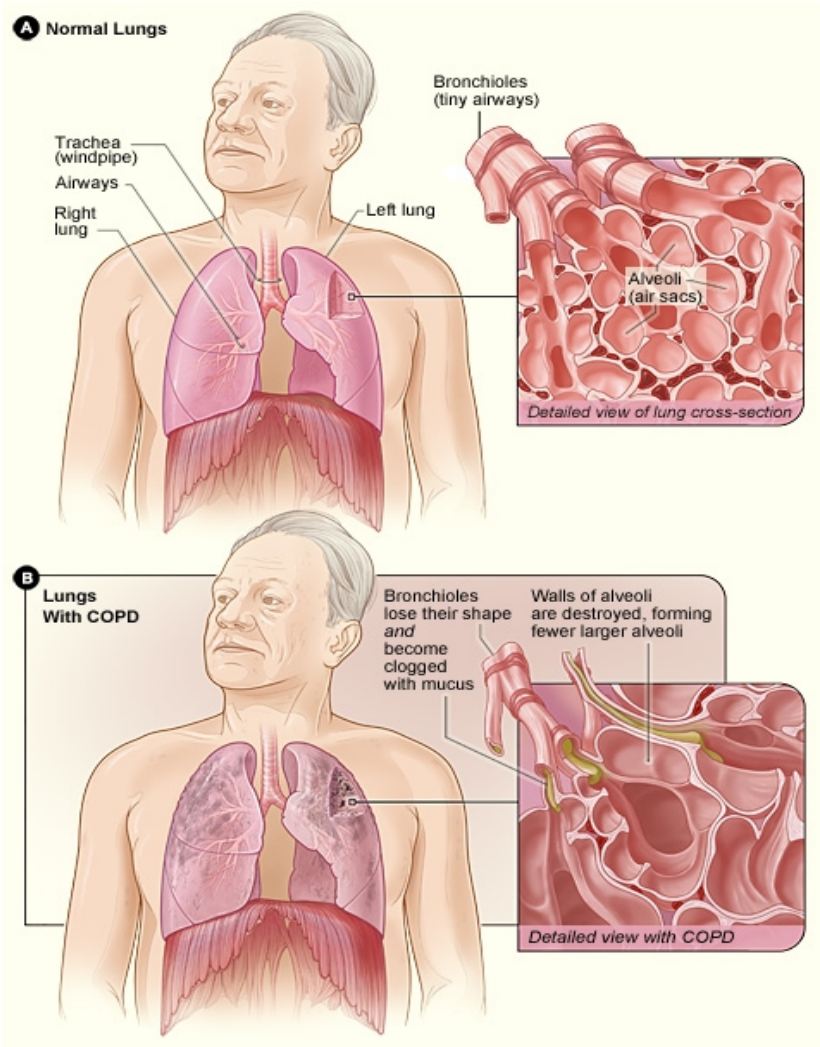



**Figure 2.14** Normal lungs and lungs with COPD**.** A shows the location of the lungs and airways in the body. The inset image shows a detailed cross-section of the bronchioles and alveoli. Figure B shows lungs damaged by COPD. The inset image shows a detailed cross-section of the damaged bronchioles and alveolar walls. See: http://www.nhlbi.nih.gov/.

COPD occurs in 34 out of 1000 greater than 65 years old. In England, an estimated 842.100 of 50 million people have a diagnosis of COPD; approximately one person in 59 receiving a diagnosis of COPD at some point in their lives. In the United States, the prevalence of COPD is approximately 1 in 20 or 5 %, approximately 13,5 million people in USA, or possibly approximately 25 million people if undiagnosed cases are included [12-16].

#### *2.2.2.3 Bronchiectasis*

Bronchiectasis is a disease state defined by localized, irreversible dilation of part of the bronchial tree caused by destruction of the muscle and elastic tissue. It is classified as an obstructive lung disease, along with emphysema, bronchitis, asthma, and cystic fibrosis. Involved bronchi are dilated, inflamed, and easily collapsible, resulting in airflow obstruction and impaired clearance of secretions. Bronchiectasis is associated with a wide range of disorders, but it usually results from necrotizing bacterial infections, such as infections caused by the Staphylococcus or Klebsiella species or Bordetella pertussis. See: Gibraltar WebMD. http://www.emedicine.com/radio/topic116.htm. Retrieved 2007-06-22, [12-18].

#### *2.2.2.4 Emphysema*

Emphysema is a long-term, progressive disease of the lungs that primarily causes shortness of breath. In people with emphysema, the tissues necessary to support the physical shape and function of the lungs are destroyed. It is included in a group of diseases called chronic obstructive pulmonary disease or COPD (pulmonary refers to the lungs). Emphysema is called an obstructive lung disease because the destruction of lung tissue around smaller sacs, called alveoli, makes these air sacs unable to hold their functional shape upon exhalation. It is often caused by smoking or long-term exposure to air pollution.

Emphysema can be classified into primary and secondary. However, it is more commonly classified by location into panacinary and centroacinary (or panacinar and centriacinar, or centrilobular and panlobular).

- Panacinar (or panlobular) emphysema: The entire respiratory acinus, from respiratory bronchiole to alveoli, is expanded. Occurs more commonly in the lower lobes, especially basal segments, and anterior margins of the lungs.
- Centriacinar (or centrilobular) emphysema: The respiratory bronchiole (proximal and central part of the acinus) is expanded. The distal acinus or alveoli are unchanged. Occurs more commonly in the upper lobes.

The majority of all emphysema cases are caused by smoking tobacco. Emphysema cases that are caused by other etiologies are referred to as secondary emphysema.

Some types of emphysema are considered a normal part of aging and are found in the elderly whose lungs have deteriorated due to age. At about 20 years of age, people stop developing new alveoli tissue. In the years following the cessation of the development of new alveoli, lung tissue can start to deteriorate. This is a normal, natural part of aging in healthy people. Alveoli will die, the number of lung capillaries will decline and the elastin of the lungs will begin to break down causing a loss of pulmonary elasticity. As people age, they will also lose strength and mass in their chest muscles causing these muscles to become weaker. In addition, bones can start to deteriorate and a person's posture can change. Together, all of these age-related manifestations can cause the development of emphysema. Though not all elderly people will develop emphysema, they are all at risk of having decreased respiratory function.

Other causes of emphysema can be anything that causes the body to be unable to inhibit proteolytic enzymes in the lung. This could be exposure to air pollution, second hand smoke or other chemicals and toxins See: http://en.wikipedia.org/wiki/Emphysema, [12-18].

#### *2.2.2.5 Respiratory Failure*

The term respiratory failure, in medicine, is used to describe inadequate gas exchange by the respiratory system, with the result that arterial oxygen and/or carbon dioxide levels cannot be maintained within their normal ranges. A drop in blood oxygenation is known as hypoxemia; a rise in arterial carbon dioxide levels is called hypercapnia. The normal reference values are: oxygen $PaO_2$ greater than 80 mmHg

(11 kPa), and carbon dioxide $PaCO_2$ less than 45 mmHg (6.0 kPa). Classification into type I or type II relates to the absence or presence of hypercapnia respectively.

Type 1 respiratory failure is defined as hypoxemia without hypercapnia, and indeed the $PaCO_2$ may be normal or low. It is typically caused by a ventilation/perfusion (V/Q) mismatch; the volume of air flowing in and out of the lungs is not matched with the flow of blood to the lungs. The basic defect in type 1 respiratory failure is failure of oxygenation characterized by:

| | |
|---|---|
| $PaO_2$ | low (< 60 mmHg (8.0 kPa)) |
| $PaCO_2$ | Normal or low |
| PA-$aO_2$ | Increased |

This type of respiratory failure is caused by conditions that affect oxygenation such as: Parenchymal disease (V/Q mismatch)

Diseases of vasculature and shunts: right-to-left shunt, pulmonary embolisminterstitial lung diseases: ARDS, pneumonia, emphysema.The basic defect in type 2 respiratory failure is characterized by:

| | |
|---|---|
| $PaO_2$ | Decreased |
| $PaCO_2$ | Increased |
| PA-$aO_2$ | Normal |
| pH | Decreased |

Type 2 respiratory failure is caused by increased airway resistance; both oxygen and carbon dioxide are affected. Defined as the build up of carbon dioxide levels (PaCO2) that has been generated by the body. The underlying causes include: Reduced breathing effort (in the fatigued patient)

A decrease in the area of the lung available for gas exchange (such as in emphysema) [12-18].

### *2.2.2.6 Chronic Bronchitis*

Chronic bronchitis, a type of chronic obstructive pulmonary disease, is characterized by the presence of a productive cough that lasts for three months or more per year for at least two years. Chronic bronchitis most often develops due to recurrent injury to the airways caused by inhaled irritants. Cigarette smoking is the most common cause, followed by air pollution and occupational exposure to irritants. Chronic bronchitis is treated symptomatically. Inflammation and edema of the respiratory epithelium may be reduced with inhaled corticosteroids. Wheezing and shortness of breath can be treated by reducing bronchospasm (reversible narrowing of smaller bronchi due to constriction of the smooth muscle) with bronchodilators such as inhaled β-Adrenergic agonists (e.g., salbutamol) and inhaled anticholinergics (e.g., ipratropium bromide). Hypoxemia, too little oxygen in the blood, can be treated with supplemental oxygen. However, oxygen supplementation can result in decreased respiratory drive, leading to increased blood levels of carbon dioxide and subsequent respiratory acidosis [12-18].

### *2.2.2.7 Acute Bronchitis*

Acute bronchitis is most often caused by viruses that infect the epithelium of the bronchi, resulting in inflammation and increased secretion of mucus. Cough, a common symptom of acute bronchitis, develops in an attempt to expel the excess mucus from the lungs. Other common symptoms include sore throat, runny nose, nasal congestion (coryza), low-grade fever, pleurisy, malaise, and the production of sputum.

Acute bronchitis often develops during the course of an upper respiratory infection (URI) such as the common cold or influenza See: http://en.wikipedia.org/wiki/Bronchitis_-_cite_note-ID-0 About 90% of cases of acute bronchitis are caused by viruses, including rhinoviruses, adenoviruses, and influenza. Bacteria, including *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, and *Bordetella pertussis*, account for about 10% of cases [12-18].

Only about 5–10% of bronchitis cases are caused by a bacterial infection. Most cases of bronchitis are caused by a viral infection and are "self-limiting" and resolve themselves in a few weeks [16].

As most cases of acute bronchitis are caused by viruses, antibiotics should not be used, since they are effective only against bacteria. Using antibiotics in patients without bacterial infections promotes the development of antibiotic-resistant bacteria, which may lead to greater morbidity and mortality. Antibiotics should be prescribed only if examination of gram-stained sputum shows large numbers of bacteria present.

### 2.2.3 ICD-10

The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) is a coding of diseases and signs, symptoms, abnormal findings, complaints, social circumstances and external causes of injury or diseases, as classified by the World Health Organization (WHO) ICD-10 Chapter X: Diseases of the respiratory system.

(J40–J47) Chronic lower respiratory diseases

- (J40) Bronchitis, not specified as acute or chronic
- (J41) Simple and mucopurulentchronic bronchitis
- (J42) Unspecified chronic bronchitis
  - Chronic bronchitis NOS
  - Chronic tracheitis
  - Chronic tracheobronchitis
- (J43) Emphysema
- (J44) Other chronic obstructive pulmonary disease
- (J45) Asthma
- (J46) Status asthmaticus
- (J47) Bronchiectasis

## 2.3 GARD

### 2.3.1 Gard Worldwide

GARD is a WHO alliance. It is a voluntary alliance and not a legal entity. The legal identity of GARD emanates from WHO. In view of the legal status of GARD, all GARD projects and activities arede facto WHO projects and activities and are therefore subject to WHOreview and approval in line with WHO priorities and work plans. In this regard, GARD is an important tool in advocating for the implementation of WHO-approved guidelines and work plans [13, 14].

•All GARD activities should be in compliance with an integrated approach to NCDs and not focus on one disease only (e.g. allergic rhinitis). WhileWHO advocates for integrated national NCD policies and plans to ministries of health in low- and middle-income countries, GARD advocates for national plans on respiratory diseases, which is confusing to ministries of health in low- and middle-income countries.

•GARD activities and efforts should focus on (i) WHO priorities, such as primary care in low- and middle-income countries; (ii) prioritized NCDs, such as asthma and chronic obstructive pulmonary disease (COPD); and (iii) access to equitable care [12-14].

### 2.3.2 GARD in Turkey

GARD Turkey has more than 50 collaborating partners. Short-, medium- and long-term activities have been established within its six working groups. The working groups report to the Executive Committee, which meets once per year. The activities of GARD Turkey include:

- The Ministry of Health has been restructured and its action plan for 2010–2014 has been prepared.
- Public institutions, universities and nongovernmental organizations (NGOs) participated in the action plan.
- Sharing official information has motivated the groups. A questionnaire for COPD and asthma public awareness has been developed. Awareness and advocacy materials have been prepared, and integration with other advocacy plans is under way.
- Efforts are being made to reduce the modifiable risk factors for NCDs, such as tobacco and obesity.
- An expert panel drawn from a variety of national groups and programmes has prepared a report on the evaluation of indoor and outdoor pollution with respect to climate change.
- A workshop for education in primary care settings is being planned.
- Educators will focus on asthma, COPD, home care, pulmonary rehabilitation and tobacco control guidelines.

• Regarding the effective treatment of disease and the prevention of complications, a home-care workshop is being planned, along with integration with other NCD home-care and rehabilitation programmes.

- Reimbursement of the items for pulmonary rehabilitation and home care are being discussed.

• The monitoring group is trying to renovate the recording system and plan a new data collection system throughout the country.

• A manuscript detailing the accomplishments of GARD Turkey has been published and is available on MEDLINE [19].

### 2.3.3 GARD in Muğla

Muğla city has a GARD program and the updated information and activities can be followed on-line by the page in Figure 2.15. See: **http://www.muglasm.gov.tr/gard/gardanasayfa.asp**


**Figure 2.15** Muğla city's GARD program and the updated information and activities. See: **http://www.muglasm.gov.tr/gard/gardanasayfa.asp**

# CHAPTER 3

# RESEARCH MATERIALS, METHODOLOGY AND METHODS

## 3.1 DATA TYPES AND COLLECTION/MONITORING CRITERIA AND STAKEHOLDERS AND PLACES TO RETRIEVE DATA

### 3.1.1 Data Types and Data Retrieval Information

All the data used in this thesis work has been retrieved as being a member of the GARD in Muğla and as an authorized governmental official of Ministry of Environment with responsibilities and charges of a chemical engineer with the official corespondences/authority/permission.

#### *3.1.1.1 Demographic and Geographic Data*

Muğla's population is nearly 817.503 inhabitants including population in suburban areas, the details are given in Table 3.1 (Turkey's Statistical Yearbook, 2010).

**Table 3.1** Muğla's population of counties and villages with 2010 data.

| | Provience/City Center | | | Belde/Villages | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| **Muğla** | **Total** | **Male** | **Female** | **Total** | **Male** | **Female** | **Total** | **Male** | **Female** |
| **Bodrum** | 33.258 | 17.357 | 15.901 | 91.562 | 47.205 | 44.357 | 124.820 | 64.562 | **60.258** |
| **Datça** | 10.450 | 5.408 | 5.042 | 6.025 | 3.043 | 2.982 | 16.475 | 8.451 | **8.024** |
| **Fethiye** | 77.237 | 38.788 | 38.449 | 111.022 | 56.305 | 54.717 | 188.259 | 95.093 | **93.166** |
| **Köyceğiz** | 8.750 | 4.284 | 4.466 | 24.067 | 12.169 | 11.898 | 32.817 | 16.453 | **16.364** |
| **Marmaris** | 30.957 | 16.784 | 14.173 | 46.433 | 24.374 | 22.059 | 77.390 | 41.158 | **36.232** |
| **Milas** | 52.522 | 26.288 | 26.234 | 73.205 | 37.145 | 36.060 | 125.727 | 63.433 | **62.294** |
| **Merkez** | 60.066 | 30.334 | 29.732 | 34.894 | 17.367 | 17.527 | 94.960 | 47.701 | **47.259** |
| **Ula** | 5.683 | 2.850 | 2.833 | 18.066 | 9.062 | 9.004 | 23.749 | 11.912 | **11.837** |
| **Yatağan** | 18.051 | 9.060 | 8.991 | 27.779 | 13.893 | 13.886 | 45.830 | 22.953 | **22.877** |
| **Dalaman** | 23.761 | 12.204 | 11.557 | 10.219 | 5.210 | 5.009 | 33.980 | 17.414 | **16.566** |
| **Ortaca** | 26.426 | 13.239 | 13.187 | 15.938 | 8.063 | 7.875 | 42.364 | 21.302 | **21.062** |
| **Kavaklıdere** | 2.889 | 1.474 | 1.415 | 8.243 | 4.123 | 4.120 | 11.132 | 5.597 | **5.535** |
| **Total** | **350.050** | **178.070** | **171.980** | **467.453** | **237.959** | **229.494** | **817.503** | **416.029** | **401.474** |

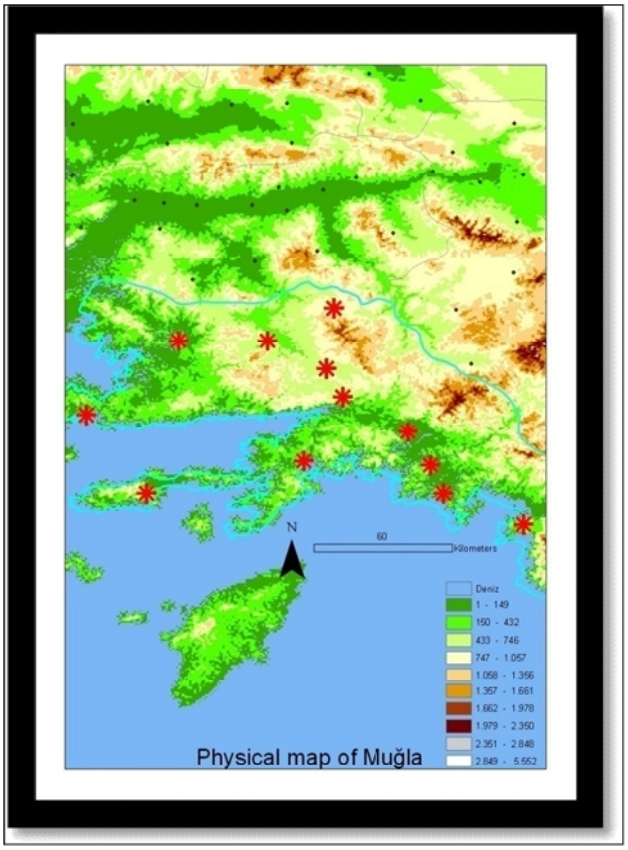



**Figure 3.1** Physical map of Muğla showing the counties and elevations from sea level.

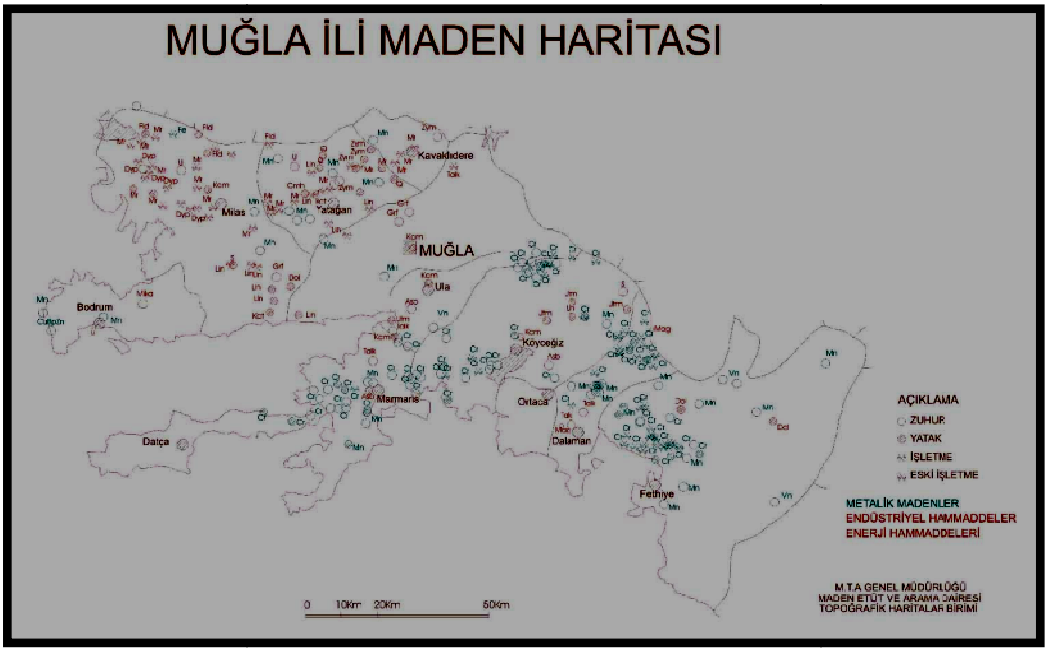



**Figure 3.2** Natural ore reserves map of Muğla city. Wealth is an indication for the air pollution natural contributors**.**

### *3.1.1.2 Air Pollution Data*

The air pollution data belongs to two criteria pollutants $SO_2$ and $PM_{10}$ collected from two stations in Yatağan and Muğla city center for three years (2008-2010). The photographs in Figures 3.3 and Figure 3.4 are during data controls at these two stations (Figures 3.5 and 3.6 respectively). Both $SO_2$ and $PM_{10}$ values can be monitored from the internet and data can be retrieved from the address http://www.havaizleme.gov.tr/Default.ltr.aspx online.

**Figure 3.3** $SO_2$ Monitoring Instrument (Brand: Horiba**).**

**Figure 3.4** $PM_{10}$ monitoring Instrument (Brand: MetOne BAM 1020).

**Figure 3.5** Photograph from Muğla Air Quality Monitoring Network Center showing its location and neighbourhood.

**Figure 3.6** Photographs from Yatağan Air Quality Monitoring Network Center showing its location and neighbourhood.

Measurement data collected from stations established in computers belonging to the Ministry of Environment and Forestry, a private network (VPN) over the GSM Modems through of the Provincial Directorates and taken by the Ministry's Central Computer. Environmental Reference Laboratory for Air Quality Monitoring Network Center in the data center computer room is in the form of hourly averages. Data communication flow chart is given in Figure 3.7.

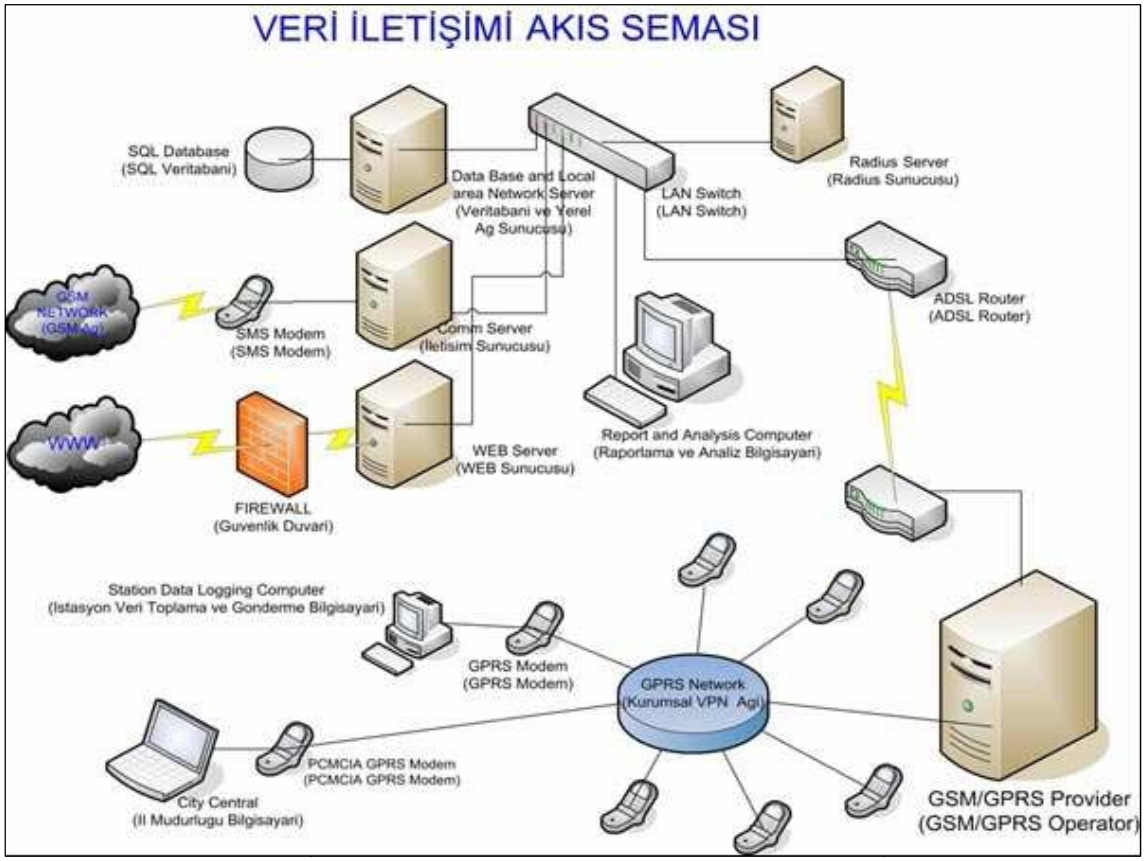



**Figure 3.7** Data communication flow chart in the Air Quality Monitoring Network Centers in Muğla and Yatağan.


**Figure 3.8** The on-line air quality and pollution data as transferred by the data communication system to follow the air quality for various parameters at different centers in Turkey via an interactive map. See: http://www.havaizleme.gov.tr/Default.ltr.aspx

.

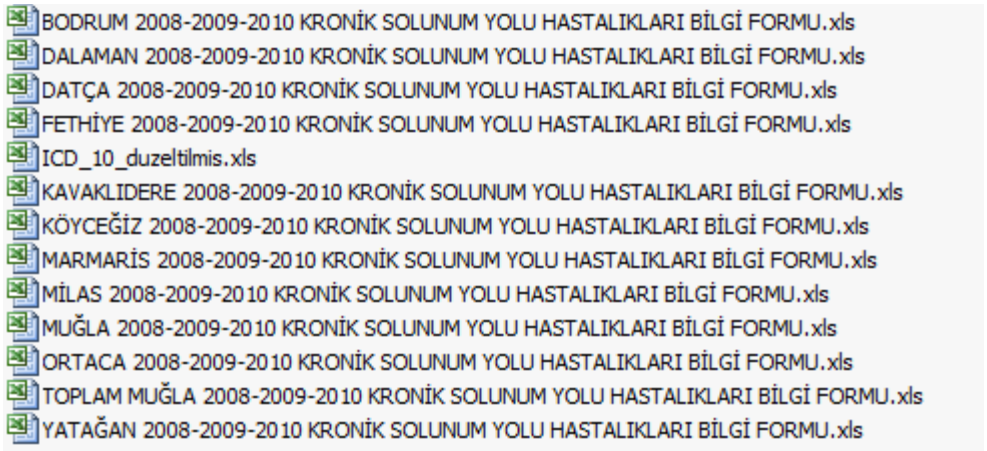
### *3.1.1.3 Sources of Air Pollution in Muğla City*

**Table 3.2** The number of mines in Muğla's counties.

| **Counties of Muğla** | **The number of mines producing air criteria pollutants especially PMs** |
|---|---|
| Center of Muğla | 46 |
| Dalaman | 5 |
| Datça | 2 |
| Kavaklıdere | 23 |
| Köyceğiz | 8 |
| Ortaca | 5 |
| Ula | 7 |
| Yatağan | 48 |
| Milas | 57 |
| Fethiye | 10 |
| Bodrum | - |
| Marmaris | - |

### *3.1.1.4 Chronical Disease Data in Muğla City*

The disease raw data has been retrieved formally with the following documents and correspondence as excel files (Figure 3.9). The excel files are retrieved from Public hospitals' databases by formal communications given in Figures 3.10 and 3.11 (Private Hospital data is not available). Retrieved data contain the respiratory diseases sorted according to ICD-10 codes (given in part 2.2.3) where ICD-10 codes are retrieved from http://www.muglasm.gov.tr/. The raw patient data is given as excel format with the details of the patients given in Figure 3.9 b part.




a) The raw data retrieved as excel files.

| | Sıra No | D.Tarihi | Cinsiyet | Has.kodu | Açıklama(hastalık adı) |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | 1 | 19.06.2000 | KADIN | J45.1 | Astım |
| 3 | 2 | 07.12.2001 | ERKEK | J45.1 | Astım |

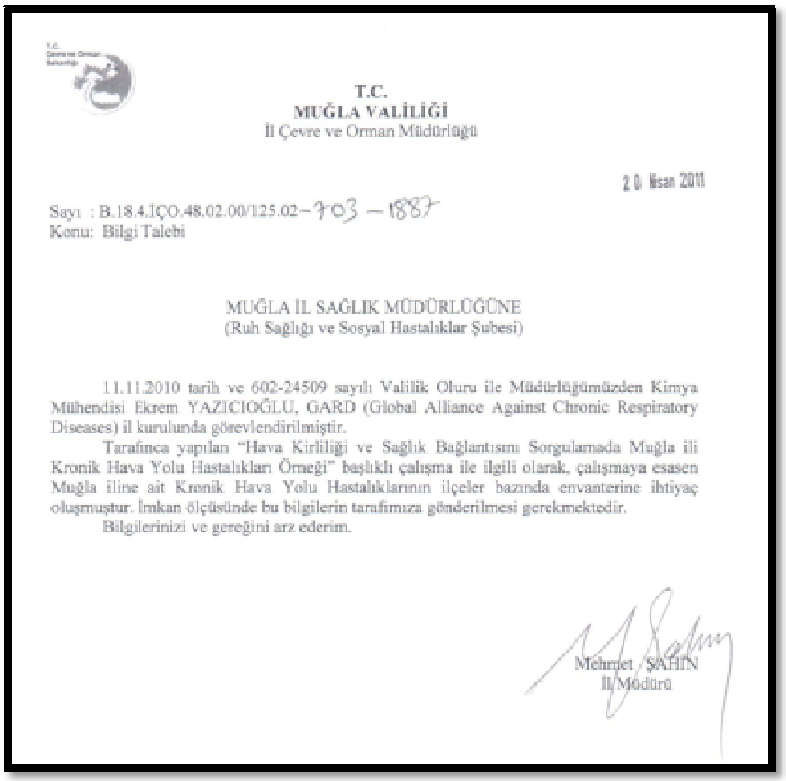
| | SIRA | YAŞ | | ICD-10 TANI KODU KHH ile ilişkili | AÇIKLAMA |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | | (Doğum Tarihi) | CİNSİYET | | (HASTALIK |
| 3 | 1 | 1935 | E | J-44 | KOAH |
| 4 | 2 | 1956 | E | J-44 | KOAH |
| 5 | 3 | 1970 | K | J-44 | KOAH |

| | | | | |
|---|---|---|---|---|
| 26 | | ERKEK | J44 | Kronik obstrüktif |
| 27 | | ERKEK | J44 | Kronik obstrüktif |
| 28 | 84 | ERKEK | J44 | Kronik obstrüktif |
| 29 | 54 | ERKEK | J44 | Kronik obstrüktif |

| | SIRA NO | DOĞUM TARİH | CİNSİYET | ICD 10KODU | TANISI |
|---|---|---|---|---|---|
| 1 | | | | | |
| 2 | 1 | 01.02.1952 | KADIN | J45 | ASTIM |
| 3 | 2 | 01.02.1934 | ERKEK | J45 | ASTIM |
| 4 | 3 | 30.03.1925 | KADIN | J45 | ASTIM |
| 5 | 4 | 01.06.1936 | ERKEK | J44 | KRONİK OBSTRÜKTİF AKCİĞER HASTALIĞI, DİĞER |
| 6 | 5 | 12.08.1934 | ERKEK | J44 | KRONİK OBSTRÜKTİF AKCİĞER HASTALIĞI, DİĞER |

b) The raw data retrieved from the state hospitals of each county with details.

**Figure 3.9** The raw data retrieved as excel files (a) from the state hospitals of each county with details (b) in a non-standart format.



T.C.
MUĞLA VALİLİĞİ
İl Çevre ve Orman Müdürlüğü

20 Nisan 2011

Sayı : B.18.4.İÇO.48.02.00/125.02-703 – 1887
Konu: Bilgi Talebi

MUĞLA İL SAĞLIK MÜDÜRLÜĞÜNE
(Ruh Sağlığı ve Sosyal Hastalıklar Şubesi)

11.11.2010 tarih ve 602-24509 sayılı Valilik Oluru ile Müdürlüğümüzden Kimya Mühendisi Ekrem YAZICIOĞLU, GARD (Global Alliance Against Chronic Respiratory Diseases) il kurulunda görevlendirilmiştir.

Tarafınca yapılan "Hava Kirliliği ve Sağlık Bağlantısını Sorgulamada Muğla ili Kronik Hava Yolu Hastalıkları Örneği" başlıklı çalışma ile ilgili olarak, çalışmaya esasen Muğla iline ait Kronik Hava Yolu Hastalıklarının ilçeler bazında envanterine ihtiyaç oluşmuştur. İmkan ölçüsünde bu bilgilerin tarafımıza gönderilmesi gerekmektedir.

Bilgilerinizi ve gereğini arz ederim.

Mehmet ŞAHİN
İl Müdürü

**Figure 3.10** Formal letters to retrieve data for chronical airway diseases from Muğla counties to be used in this thesis.

T.C.
MUĞLA VALİLİĞİ
İL SAĞLIK MÜDÜRLÜĞÜ

Sayı :B.104.İSM.4.48.08.- 212.02.01- 470 -9277 20.04.2011
Konu: Türkiye KHH Önleme ve Kontrol Programı Hk. Bilgi Talebi

ÇEVRE VE ORMAN İL MÜDÜRLÜĞÜ'NE
MUĞLA

İlgi: 20.04.2011 tarih ve 703–1887 sayılı yazınız.

İlgi sayılı yazınıza istinaden "Hava Kirliliği ve Sağlık Bağlantısını Sorgulamada Muğla İli Kronik Hava Yolu Hastalıkları Örneği" başlıklı çalışmanızla ilgili olarak, talep etmiş olduğunuz Muğla İline ait Kronik Hava Yolu Hastalıklarının ilçeler bazında envanterinin sayfa dökümünün çok uzun olması sebebi ile il GARD kurulu üyesi Kimya Müh.Ekrem Yazıcıoğlu'na elektronik ortamda ekrem20@yahoo.com adresine gönderilmesi uygun görülmüştür.

Bilgilerinize arz ederim.

Dr. İskender GENCER
Sağlık Müdürü

**Figure 3.11** Formal letter of consent for the chronical airway diseases of Muğla data to be sent via e-mail to Ekrem Yazıcıoğlu ekrem20@yahoo.com (me) to be used in this thesis.

### 3.1.2 Stakeholders

Stakeholders in GARD; their names, affiliations, addresses, web-pages and formal information necessary in the thesis given below.

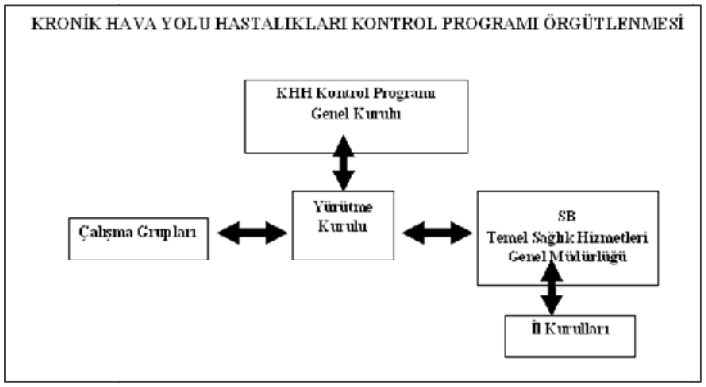
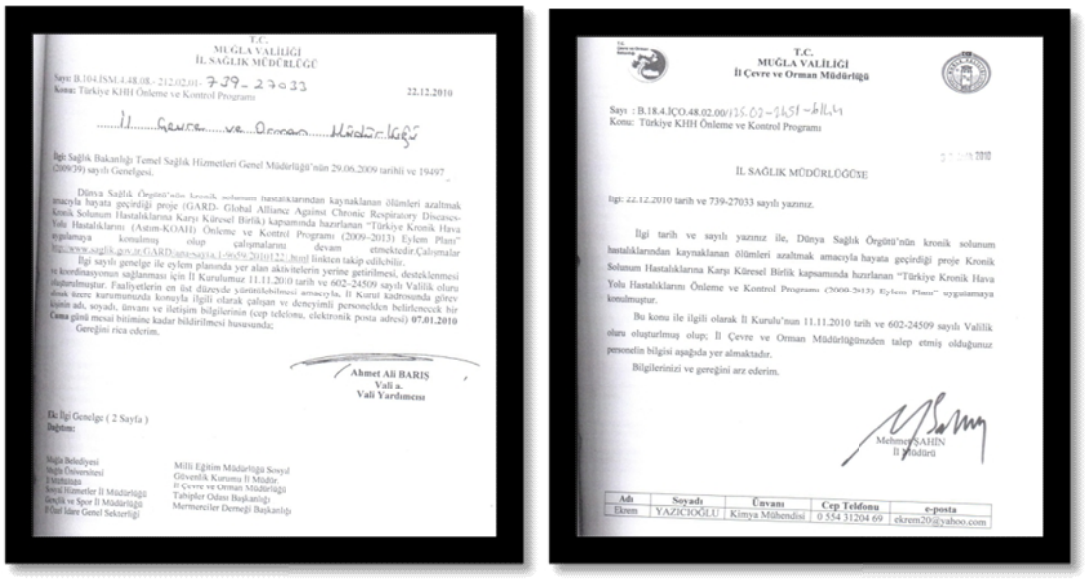



**Figure 3.12** GARD organization scheme in Turkey and Muğla city.

According to the organization scheme in Figure 3.12 the below formal letters and documents (scanned) in Figure 3.13 are put in this materials and methods part to show the formal procedures to be assigned to my position in GARD Muğla.



a) b)

**Figure 3.13** The scanned papers in (a) part is for the charging of a staff to be responsible as a qualified member of GARD in Muğla and in (b) part the formal reply of governmental authorities.

Assignment of Ekrem Yazıcıoğlu (me) in GARD as a chemical engineer and the other stakeholders of the commissions that I have been selected to is given in Figures 3.14 and 3.15 with different information and contact details of the members.

| TÜRKİYE KHH ÖNLEME VE KONTROL PROGRAMI İL YÜRÜTME KURULU | | | | | | |
|---|---|---|---|---|---|---|
| SIRA | KURUMU | ADI-SOYADI | GÖREVİ | İLETİŞİM BİLGİLERİ | | İMZA |
| 1 | İL SAĞLIK MÜDÜRLÜĞÜ | DR.ENDER KASAP (BAŞKAN) | SAĞLIK MÜDÜR YARDIMCISI | 0 532 253 96 47 | dr.enderkasap@gmail.com | √ |
| 2 | İL SAĞLIK MÜDÜRLÜĞÜ | DR.ÖNER ÖNKAŞ | RUH SAĞ.VE SOS. HAST.ŞB.MD. | 0 505 236 66 18 | oneronkas@gmail.com | √ |
| 3 | İL SAĞLIK MÜDÜRLÜĞÜ | FİLİZ SALIŞ | SAĞLIK EĞİTİMİ ŞB.MD. | 0 505 671 19 42 | filizsalis@hotmail.com | √ |
| 4 | MUĞLA BELEDİYE BAŞKANLIĞI | DR.CAFER ŞAHİN | MUĞLA BELEDİYESİ SAĞLIK İŞLERİ MD. | 0 533 594 99 46 | dr_cafersahin@hotmail.com | √ |
| 5 | MUĞLA ÜNİVERSİTESİ | Yrd.Doç.Dr.METİN PİÇAKÇİEFE | HALK SAĞLIĞI UZMANI | 0 536 256 34 49 | mpicakciefe@hotmail.com | √ |
| 6 | MİLLİ EĞİTİM MÜD. | GÜLİSTAN YILMAZOĞLU | SAĞLIK MESLEK LİSESİ MD. | 0 532 407 40 00 | gulyilmazl@hotmail.com | √ |
| 7 | İL ÇEVRE VE ORMAN MÜD. | EKREM YAZICIOĞLU | KİMYA MÜHENDİSİ | 554 312 04 69 | ekrem20@yahoo.com | √ |
| 8 | TABİPLER ODASI BAŞKANLIĞI | Uzm.Dr.SİBEL BARUT KESKİN | GÖĞÜS HAST. UZMANI | 0 535 278 93 89 | drsibelkeskin@hotmail.com | √ |
| 9 | TÜRK TORAKS DERNEĞİ MUĞLA TEMSİLCİSİ | Uzm.Dr.ALİ DİKER | GOGUS HAST. UZMANI | 0 532 436 14 68 | dralidiker@hotmail.com | √ |
| 10 | FETHİYE DEVLET HASTANESİ | Uzm.Dr. MESUT KOSKU | GÖĞÜS HAST. UZMANI | 0 532 505 63 83 | kosku@hotmail.com | √ |

**Figure 3.14** Member information and contact details in GARD Muğla.


**Figure 3.15** Member information and contact details in GARD Muğla.

As it is obvious in Figures 3.14 ve 3.15 there exists two different GARD commissions in Muğla city in both of which I have responsibilities. These two commissions are “Provincial Executive Committee and Provincial Executive Committee for the Prevention and Control Program”. Some details related with my responsibilities and fulfillments of these responsibilities are listed with details in Tables 3.4 and 3.5.

### 3.1.3 Data Providers of GARD

The data for GARD can be retrieved from the stakeholders given in Table 3.3 with thee columns to classify as the ones that is controlled under Ministry of Health, other governmental organizations and universities/non-governmental organizations.

**Table 3.3** Data providers of GARD.

| Republic of Turkey Ministry of Health | Other Governmental Organizations | Universities and Non-Governmental Organizations (NGOs) |
|---|---|---|
| **Ministry of Health** | Ministry of National Education | Turkish Thoracic Society |
| **General Directorate of Primary Health Care Services** | Ministry of Industry And Commerce | Turkish National Society Of Clinical |
| **Department Of Non-Communicable Diseases And Chronic Conditions** | Turkish Statistical Institute | Allergy And Immunology |
| **Respiratory System Diseases Unit** | Ministry of Interior | Turkish Pharmacists Association |
| **Department of Health Promotion** | Ministry of Labour and Social Security | The Society Of Public Health |
| **General Directorate of Pharmaceuticals and Pharmacy** | Social Security Institution | Turkish Society Of Family Practioner |
| **General Directorate of Curative Services** | General Directorate For Occupational Health And Safety | The Society Of General Physicians |
| **General Directorate of Health Education** | World Health Organization (Regional Representative) | Medical Oncology Society |
| **General Directorate of Maternal/Child Health and Family Planning** | Ministry of Environment and Forestry | Turkish Medical Association |
| **Personnel General Directorate** | Ministry of Finance | Turkish Association Of Municipalities |
| **Strategy Development Presidency** | Ministry of Agriculture | |
| **EU Coordination Department** | General Directorate of Youth and Sport | |
| **Information Processing Department** | Tobacco, Tobacco Products and Alcoholic Beverages Regulatory Authority | |
| **Cancer Control Department** | Radio and Television Supreme Council | |
| **Tuberculosis Control Department** | General Directorate of Turkish Radio and Television Corporation | |
| **Refik Saydam Hygiene Center Presidency** | The Presidency of Religious Affairs | |
| **School of Public Health** | State Planning Organization | |

#### *3.1.3.1 Data Mining Tools*

Excel filtering process has been used to help classifying the raw data for patients and the criteria pollutants.

#### *3.1.3.2 Data Retrieval Addresses*

The various data and information used in the thesis has been retrieved from the addresses in Table 3.4 freely without further permission unless otherwise mentioned.

**Table 3.4** Data types and retrieval addresses.

| **Data types and descriptions** | **Reference addresses** |
|---|---|
| $PM_{10}$-$SO_2$ Values | http://www.havaizleme.gov.tr/ |
| Patient Data | http://www.muglasm.gov.tr/ |
| Enviromental Permits | http://eizin.cevreorman.gov.tr/Anasayfa.aspx?sflang=tr |
| Meteorology Data | http://dmi.gov.tr/tahmin/il-ve-ilceler.aspx?m=MUGLA |
| Provincial Environment and Forestry Directorate | http://mugla.cevreorman.gov.tr/Mugla/AnaSayfa.aspx?sflang=tr |
| Ministry of Environment and Forestry | http://www.ormansu.gov.tr/COB/AnaSayfa.aspx?sflang=tr |
| Provincial Healty Directorate | http://www.muglasm.gov.tr/pages.asp?Pagem=Kronik%20Hava%20Yolu%20Hastal%FDklar%FDn%FD%20%D6nleme%20ve%20Kontrol%20Program%FD&cat_id=4&cat2_id=12&wid=43 |
| Mines in Muğla's counties | http://www.mutso.org.tr/default.asp (Muğla Chamber of Commerce and Industry)<br>http://mitso.org.tr/default.asp (Milas Chamber of Commerce and Industry)<br>http://www.fto.org.tr/index.aspx (Fethiye Chamber of Commerce and Industry)<br>http://www.mto.org.tr/ (Marmaris Chamber of Commerce and Industry)<br>http://www.bodto.org.tr/ (Bodrum Chamber of Commerce and Industry) |

### 3.1.4 Conferences, Meetings, Briefings, Seminars Attended, Given and Followed

During and in preparation to this thesis work various important conferences, meetings, briefings and seminars have been attended, given and followed. Below in Table 3.5 is the list of most important ones that there exist a web address for or

published in a proceeding. Others are given as personel communication type of data or mentioned where needed throughout the thesis.

**Table 3.5** Conferences, seminars given and attended and news followed with addresses.

| **Subject Title** | **Reference addresses** |
|---|---|
| TRAFİK KAYNAKLI EMİSYON HESABINDA KARŞILAŞILAN GÜÇLÜKLER, Ekrem YAZICIOĞLU, Ferhat KARACA, 01/10/2010 IV. HAVA KİRLİLİĞİ VE KONTROLÜ SEMPOZYUMU, ODTÜ KKM – ANKARA, 25-27 EKİM 2010 | http://www.hkk2010.metu.edu.tr/ |
| Seminar | http://www.mugla-bld.gov.tr/haberler/haberler2011expanded.html#242 |
| Muğla GARD Commission | http://www.muglasm.gov.tr/pages.asp?Pagem=Kronik%20Hava%20Yolu%20Hastal%FDklar%FDn%FD%20%D6nleme%20ve%20Kontrol%20Program%FD&cat_id=4&cat2_id=12&wid=43 |
| Control News in Muğla | http://www.bodrumbaskisi.com/haber/index.php/hava-kirliligi-kontrol-altinda |
| Control News in Muğla | http://www.mugladevrim.com.tr/index.php?option=com_content&view=article&id=8962:kalorifercilere-eitim-semineri-&catid=1:son-haberler |
| Control News in Muğla | http://www.mugladevrim.com.tr/index.php?option=com_content&view=article&id=5992:mulada-kalorifer-daireleri-denetlendi |
| Muğla GARD Commission | http://www.muglasm.gov.tr/pages.asp?Pagem=Kronik%20Hava%20Yolu%20Hastal%FDklar%FDn%FD%20%D6nleme%20ve%20Kontrol%20Program%FD&cat_id=4&cat2_id=12&wid=43 |

### 3.1.5 Questions To Be Answered To Bridge The Gap From Sources To Health Outcomes [1].

1. How does our understanding of the health effects of air pollutants (singly or in mixtures) help identify pollutants that can be linked to sources the control of which would provide maximal health benefits? (overarching theme)
2. How reliable are methods (measurements and models) and approaches (epidemiological and toxicological) for studying and quantifying the links between air pollutants (species and or sources) and adverse health effects?
3. How do relevant pollutant properties vary in space and time from sources and in ambient air? What are the implications of these variations for population exposure?
4. What advances have been made in understanding the relationships between exposure, both spatially and temporally, and estimates of dose that tie to health outcomes?
5. Are patterns emerging that relate component(s) of air pollution and/or source types to mechanisms? What is the status of identifying and measuring biomarkers of exposure and/or adverse health effects from air pollution?
6. Who are the susceptible populations? What drives different susceptibilities to the same or different air pollutants? Are there susceptibility traits associated with specific health outcomes that are common among the subpopulations?
7. What roles do confounding or other factors have in increasing, decreasing, or obscuring attribution of the true health effects from ambient air pollutants?
8. Do actions taken to improve air quality result in reduced ambient concentrations of relevant pollutants, exposure, and health effects? Have we encountered unintended consequences?
9. What are the policy implications of our improved understanding of the source to health effect paradigm?

## 3.2 METHODS

### 3.2.1 GIS Evaluations of Various Health and Pollution Data Using ARCVIEW 10 Program

ArcView is a desktop GIS software that provides geographic data visualization, mapping, management, and analysis capabilities along with the ability to create and edit data.

### 3.2.2 Statistical and Graphical Evaluations of Various Health, Pollution and Epidemological Data

Microsoft Excel basic tools for statistical calculations and graphical evaluations have been used to evaluate health data in calculating the prevalence and population-adjusted prealence of the most frequent chronic airway diseases in Muğla city given in Table 4.3 and pollution data in calculating the means to show the cumulative values for $SO_2$ and $PM_{10}$ and the limit values and standarts of EU, EPA and Turkish Ministry of Health.

### 3.2.3 Methods to Answer Some of the Questions in 3.1.5

1. How does our understanding of the health effects of air pollutants (singly or in mixtures) help identify pollutants that can be linked to sources the control of which would provide maximal health benefits? (overarching theme).
2. How reliable are methods (measurements and models) and approaches (epidemiological and toxicological) for studying and quantifying the links between air pollutants (species and or sources) and adverse health effects?

- $PM_{2.5}$ and less sized detection filters should be used (Figure: 2.5) [2, 7, 20].
- Data collected should be in the same formats and units with the universal data [8, 9].

3. How do relevant pollutant properties vary in space and time from sources and in ambient air? What are the implications of these variations for population exposure?
4. What advances have been made in understanding the relationships between exposure, both spatially and temporally, and estimates of dose that tie to health outcomes?
5. Are patterns emerging that relate component(s) of air pollution and/or source types to mechanisms? What is the status of identifying and measuring biomarkers of exposure and/or adverse health effects from air pollution?

6. Who are the susceptible populations? What drives different susceptibilities to the same or different air pollutants? Are there susceptibility traits associated with specific health outcomes that are common among the subpopulations?

- Susceptibility criteria should be evaluated for each patient according to medical history, anamnesis.
- Detailed pedigrees should be drawn for each patient to assess genetic and environmental contribution to the disease.
- Susceptibility genes such as GSTs, CYPs, NATs should be genotyped for personalized therapies [11, 21].
- Drug-metabolizing enzyme polymorphisms; Phase I and Phase II drug metabolism; NAT2; G6PD; Exposure assessment;TPMT, CYP2D6, NQO1 and PON genes can be considered more specifically [11].
- The patients' prognosis should be followed by routine and detailed progress and course reportings done by phone calls.

7. What roles do confounding or other factors have in increasing, decreasing, or obscuring attribution of the true health effects from ambient air pollutants?

- Need for more demographic information to understand the real contribution of air pollutant exposure on the disease prevalence.

8. Do actions taken to improve air quality result in reduced ambient concentrations of relevant pollutants, exposure, and health effects? Have we encountered unintended consequences?
9. What are the policy implications of our improved understanding of the source to health effect paradigm?

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## 4.1 ANALYSIS RESULTS AND DISCUSSION OF MUĞLA'S AIR POLLUTION DATA.

Muğla's air pollution data collected from Yatağan and Muğla stations are retrieved, examined and filtered according to many confounding factors discussed under related titles are converted finally to the information available in Tables 4.1 and 4.2 and Figures 4.1 and 4.2 for the years 2008-2010. Many technical details are given as a summary in these tables and figures that can have an effect on our discussions. Numbers of measurements for both stations Yatağan and Muğla and for both $PM_{10}$ and $SO_2$ in 2008 are very low, that is because the stations started to take data after that time on.

**Table 4.1** $PM_{10}$ and $SO_2$ data statistics for 3 years (2008-2010) for Yatağan Station.

**YATAĞAN STATION**

| | Measured Average Values | | Number of measurements | |
|---|---|---|---|---|
| Year/Parameter | $PM_{10}$ 24H ($\mu g/m^3$) | $SO_2$ 24H ($\mu g/m^3$) | $PM_{10}$ 24H | $SO_2$ 24H |
| 2008 | 72 | 28 | 29 | 29 |
| 2009 | 59 | 19 | 333 | 333 |
| 2010 | 59 | 22 | 282 | 282 |

**Table 4.2** $PM_{10}$ and $SO_2$ data statistics for 3 years (2008-2010) for Muğla Station.

**MUĞLA STATION**

| | Measured Average Values | | Number of Measurements | |
|---|---|---|---|---|
| Year/Parameter | $SO_2$ 24H ($\mu g/m^3$) | $PM_{10}$ 24H ($\mu g/m^3$) | $SO_2$ 24H | $PM_{10}$ 24H |
| 2008 | 75 | 72 | 13 | 12 |
| 2009 | 42 | 69 | 255 | 255 |
| 2010 | 60 | 71 | 292 | 292 |

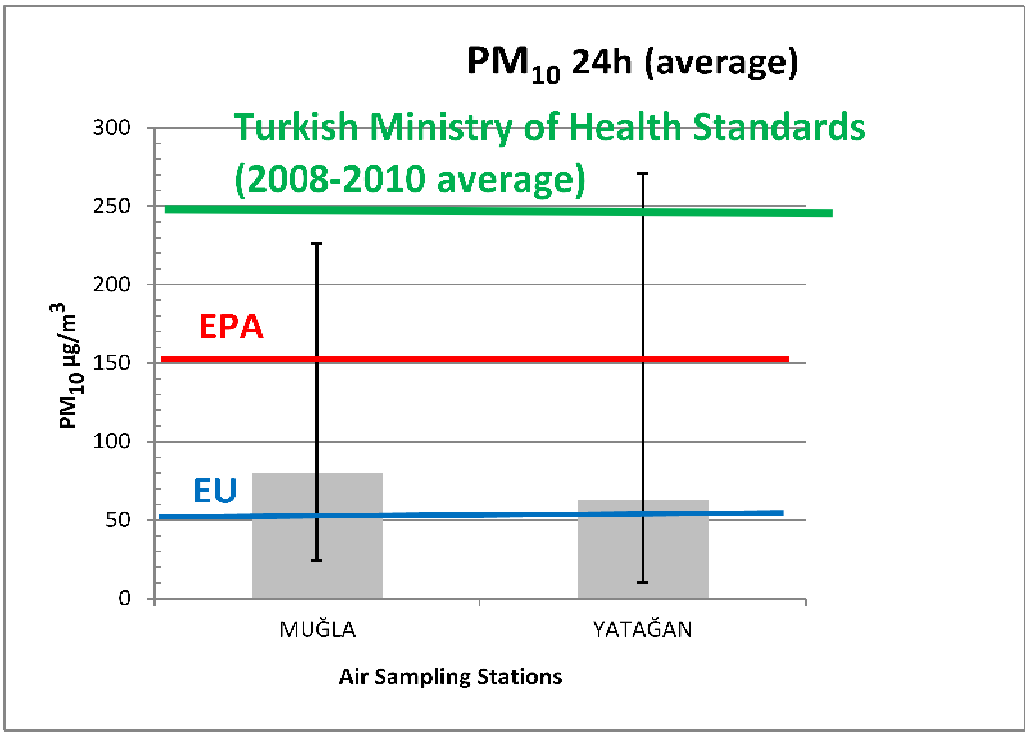



**Figure 4.1** $PM_{10}$ 24h data averages of Muğla and Yatağan air sampling stations for years 2008-2009-2010 showing the smallest and the highest values recorded for the two stations and the values that exceed EPA, EU and Turkish standards.

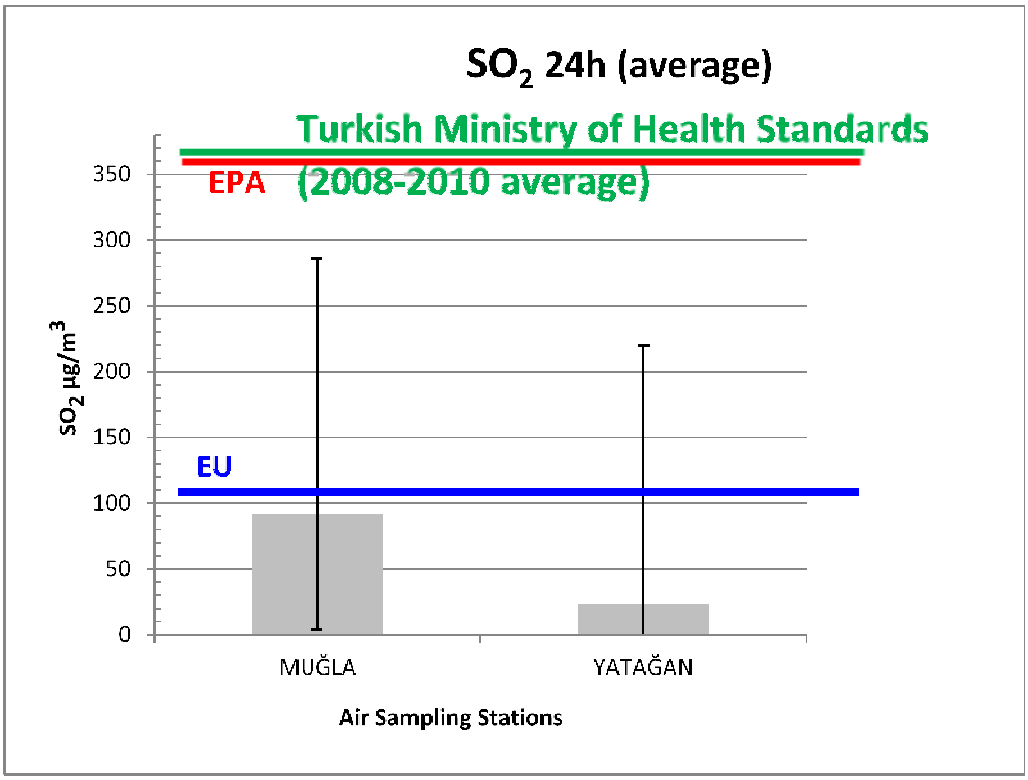
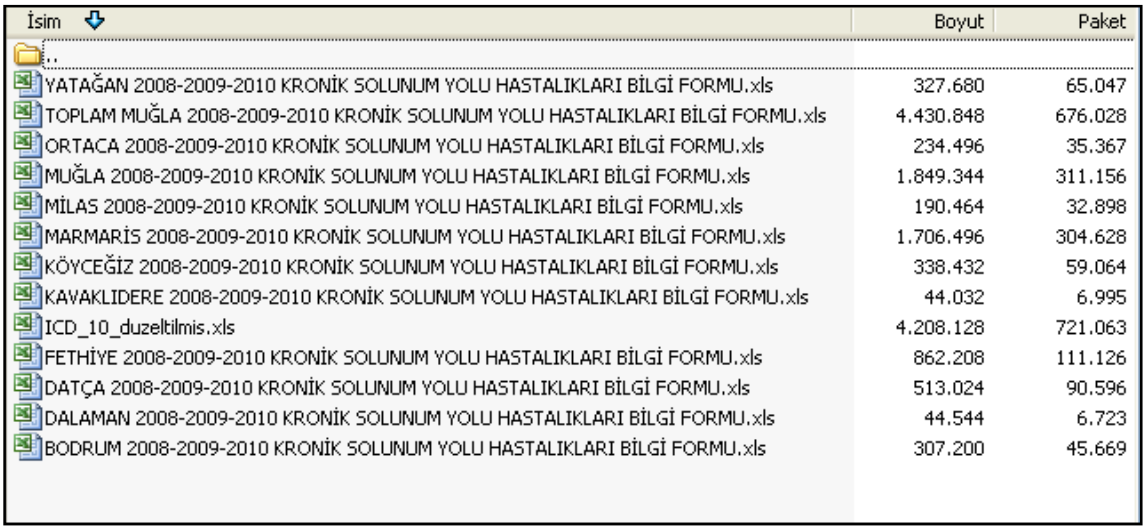



**Figure 4.2** $SO_2$ 24h data averages of Muğla and Yatağan air sampling stations for years 2008-2009-2010 showing the smallest and the highest values recorded for the two stations and the values that exceed EPA, EU and Turkish standards.

## 4.2 ANALYSIS RESULTS AND DISCUSSION OF MUĞLA'S CHRONICLE AIRWAY DISEASE DATA WITH GIS MAP EVALUATIONS AND THE CORRELATION OF CRITERIA POLLUTANTS' MEASUREMENTS AND CHRONICLE AIRWAY DISEASE DATA IN MUĞLA CITY.

Raw data (Figure 4.3) as retrieved from the hospitals are given first and the way it is analyzed and the discussions and evaluation are given in following Table 4.3, 4.4 and Figures 4.4 - 4.19.



| İsim | Boyut | Paket |
|---|---|---|
| .. | | |
| YATAĞAN 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 327.680 | 65.047 |
| TOPLAM MUĞLA 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 4.430.848 | 676.028 |
| ORTACA 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 234.496 | 35.367 |
| MUĞLA 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 1.849.344 | 311.156 |
| MİLAS 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 190.464 | 32.898 |
| MARMARİS 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 1.706.496 | 304.628 |
| KÖYCEĞİZ 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 338.432 | 59.064 |
| KAVAKLIDERE 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 44.032 | 6.995 |
| ICD_10_duzeltilmis.xls | 4.208.128 | 721.063 |
| FETHİYE 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 862.208 | 111.126 |
| DATÇA 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 513.024 | 90.596 |
| DALAMAN 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 44.544 | 6.723 |
| BODRUM 2008-2009-2010 KRONİK SOLUNUM YOLU HASTALIKLARI BİLGİ FORMU.xls | 307.200 | 45.669 |

**Figure 4.3** Raw hospital data excel files**.**

The limited epidemiological public hospital data were summarized with Tables 4.3 and 4.4 and Figures 3.9 a and b and 4.4.

**Table 4.3** Muğla city and counties' total chronic airway diseases prevalence according to gender in years 2008-2009-2010.

| Most Prevalent Chronic Airway Diseases in Muğla | Male | Female |
|---|---|---|
| Asthma | 6532 | 9577 |
| COPD | 13722 | 9577 |
| Emphysema | 12 | 5 |
| Bronchiectasis | 161 | 164 |
| Other Chronic Obstructive Pulmonary Disease | 5 | 3 |
| Simple and Mucopurulentchronic Bronchitis | 27 | 14 |

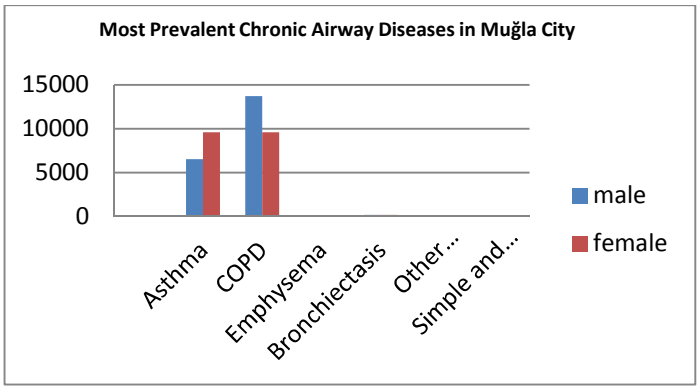



**Figure 4.4** Most prevalent chronic airway diseases in Muğla city with gender differences (cumulative data for 2008-2010).

**Table 4.4** Prevalance of Chronic Airway Diseases in Muğla City and Counties in years 2008-2009-2010 (numbers are cumulative for three years).

| Location | Asthma | COPD | Emphysema | Bronchiectasis | Simple and Mucopurulentchronic Bronchitis | Unspecified Chronic bronchitis | Respiratory Failure | Bronchitis, not Specified as Acute or Chronic | Total Chronic Airway Diseases |
|---|---|---|---|---|---|---|---|---|---|
| Muğla | 10257 | 6225 | | 187 | | 282 | | **4003** | 20954 |
| Bodrum | 1910 | 1286 | | 87 | | | | | 3283 |
| Dalaman | 24 | 18 | | 6 | | | | | 48 |
| Datça | 1037 | 670 | 5 | 12 | 7 | 56 | 26 | | 1813 |
| Fethiye | 5 | 8590 | | | 28 | 215 | 2 | | 8840 |
| Kavaklıdere | | 219 | | | 1 | 43 | | | 263 |
| Köyceğiz | 702 | 244 | | | | | | | 946 |
| Marmaris | 2095 | 2738 | 12 | 40 | 3 | | | | 4888 |
| Milas | 60 | 5 | | | | | | | 65 |
| Ortaca | 1090 | 743 | | | 2 | | | **1063** | 2898 |
| Yatağan | 1095 | 1595 | | 12 | 15 | 283 | | **566** | 3566 |
| Total | 18275 | 22333 | 17 | 344 | 56 | 879 | 28 | 5632 | |

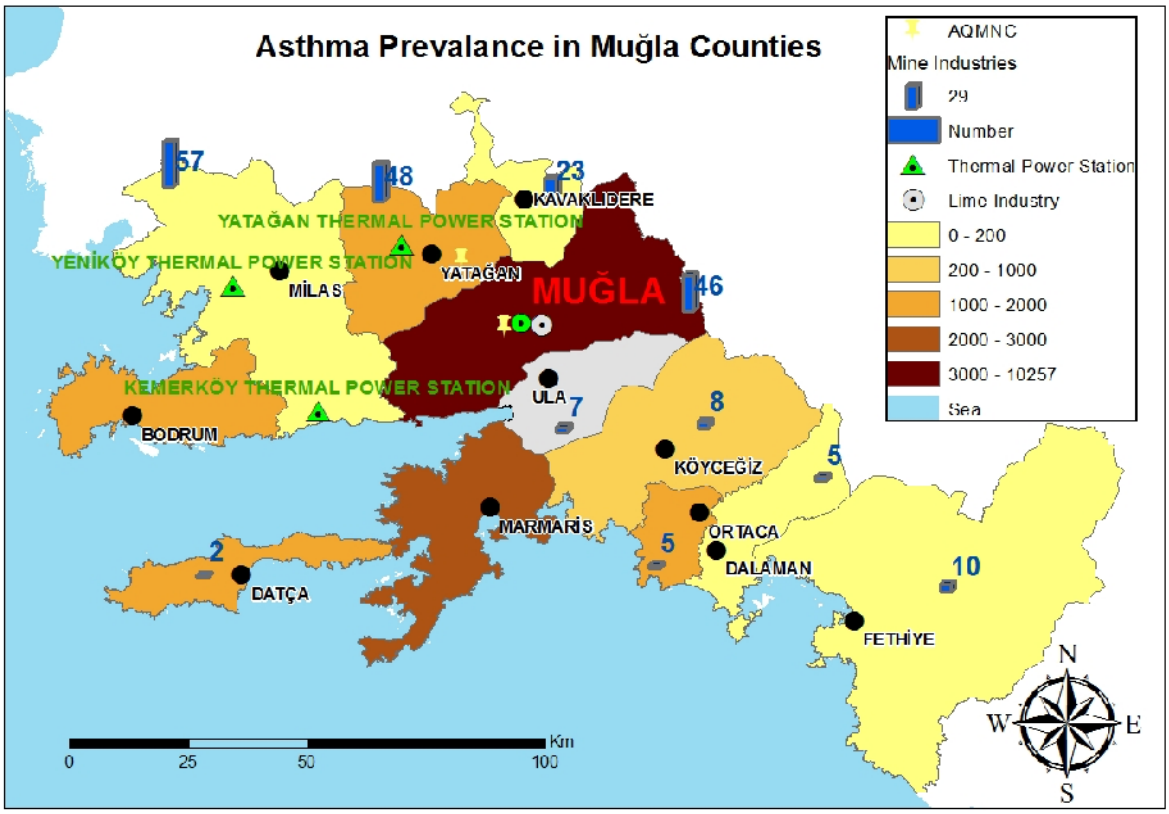



**Figure 4.5** Asthma prevalence in Muğla counties (sum of 2008-2009-2010).

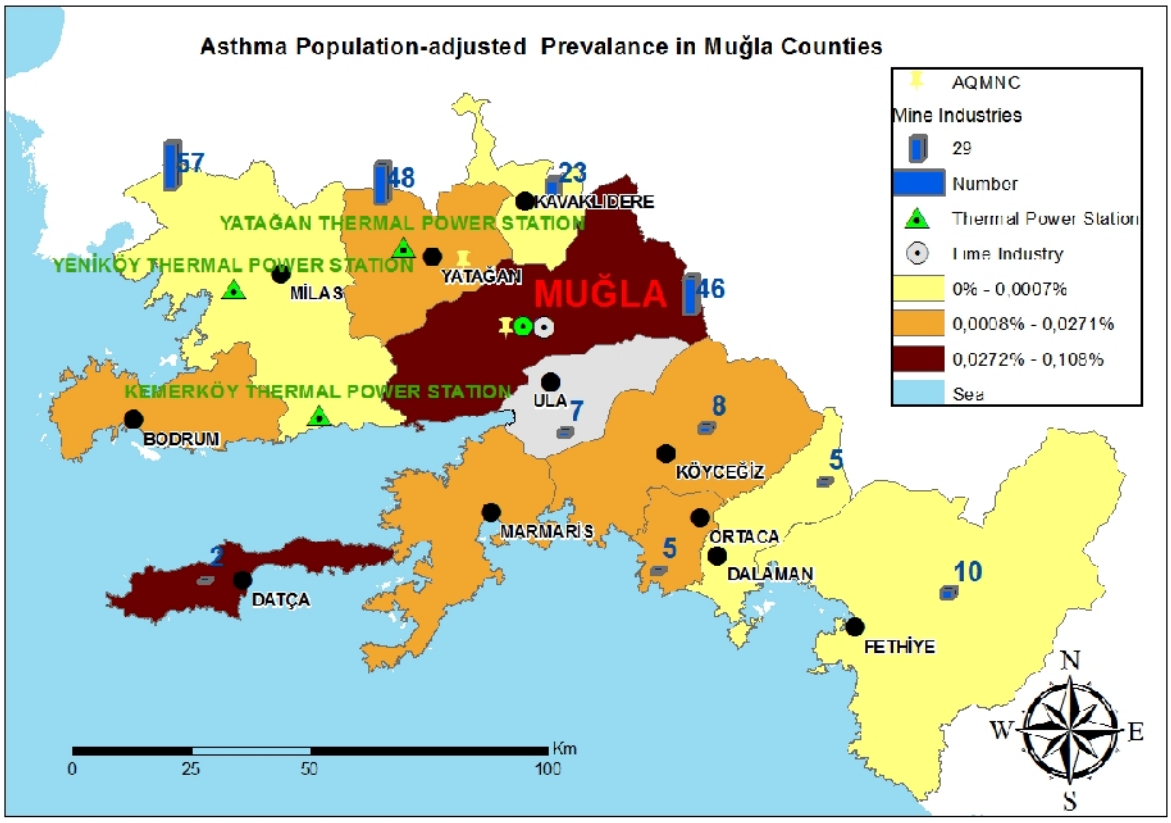



**Figure 4.6** Population-adjusted prevalence of Asthma in Muğla counties (sum of 2008-2009-2010).

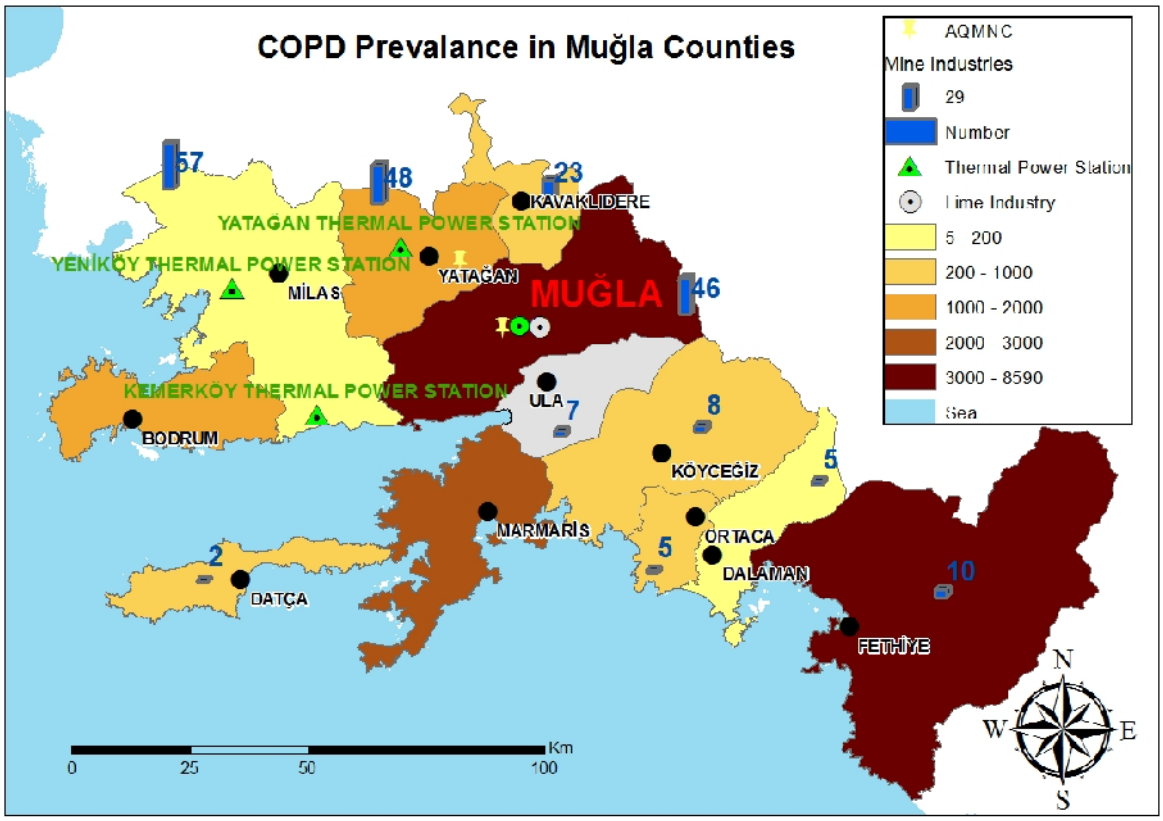



**Figure 4.7** COPD prevalence in Muğla counties (sum of 2008-2009-2010).

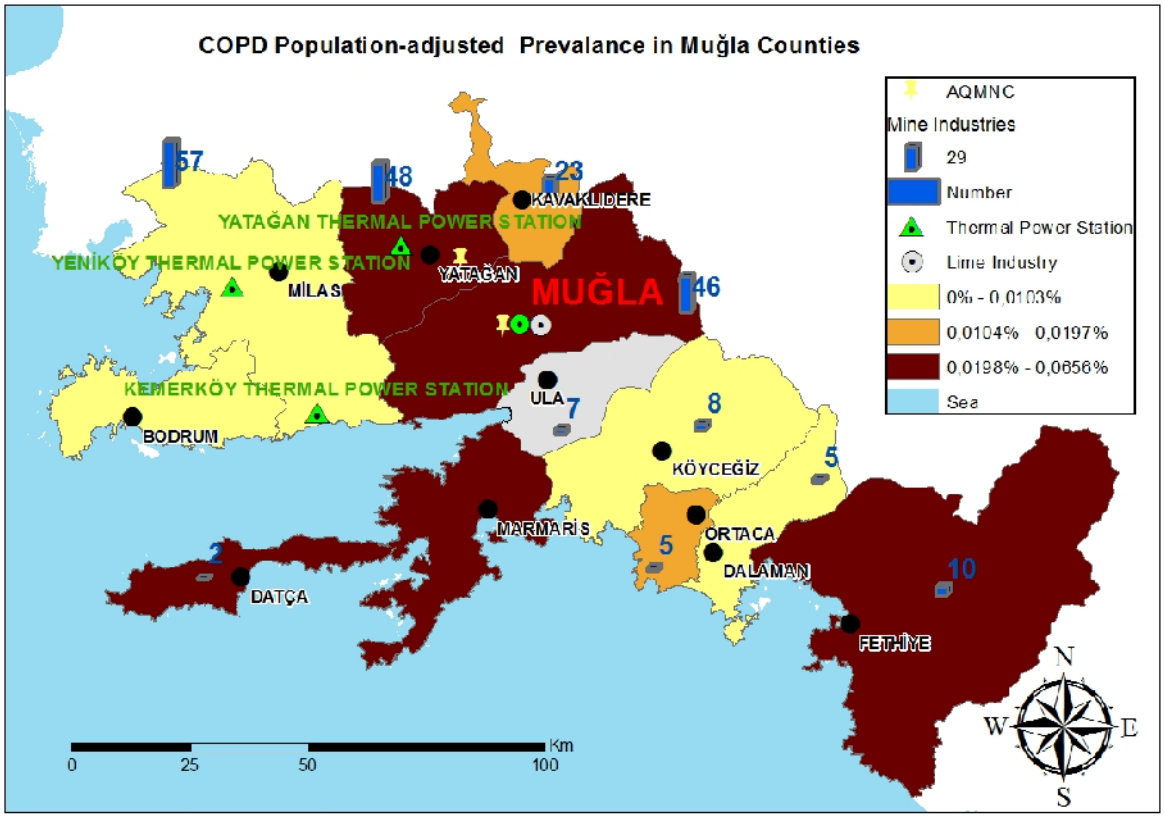



**Figure 4.8** Population-adjusted prevalence of COPD in Muğla counties (sum of 2008-2009-2010).

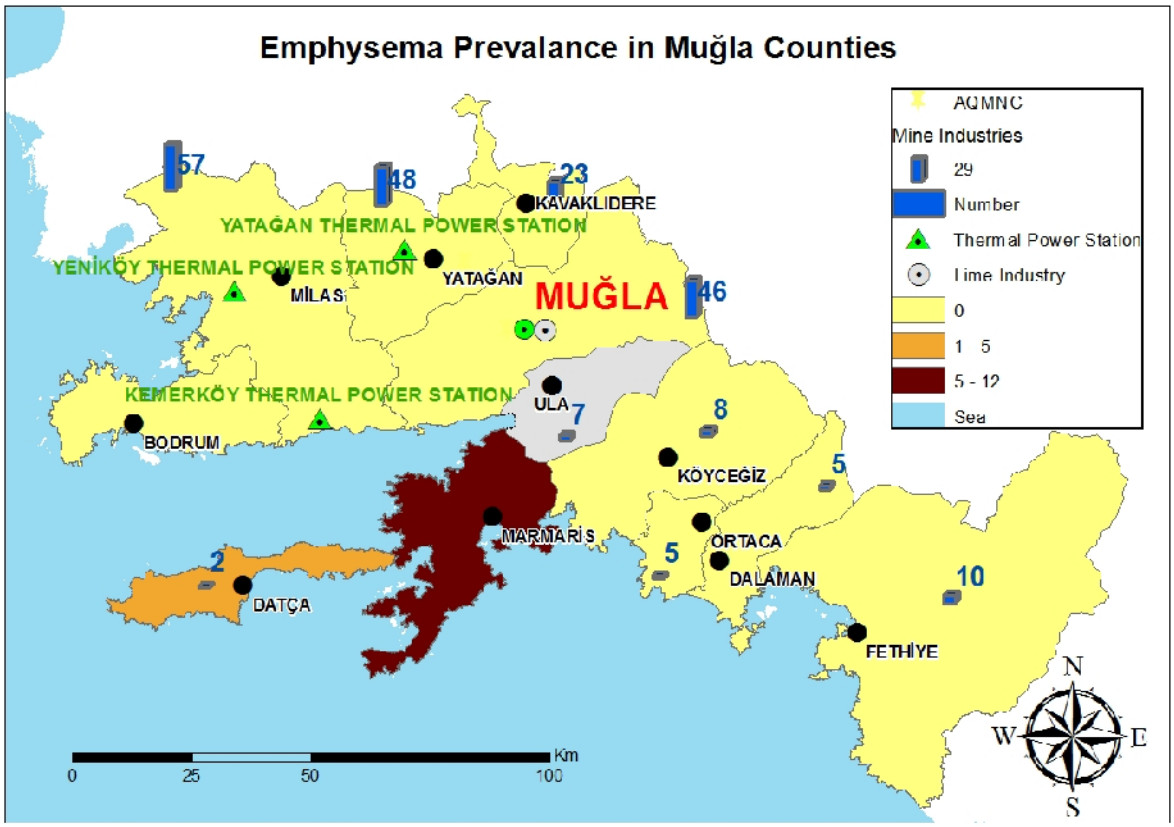



**Figure 4.9** Emphysema prevalence in Muğla counties (sum of 2008-2009-2010).

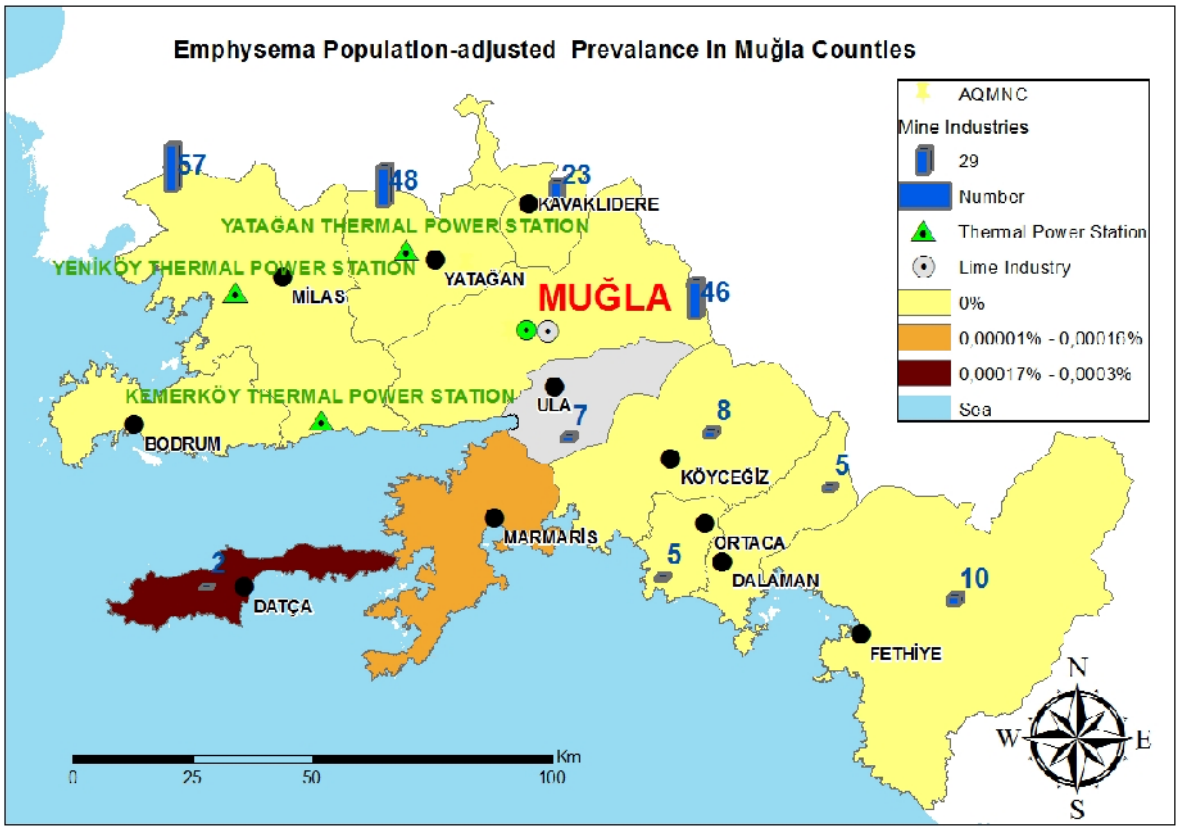



**Figure 4.10** Population-adjusted prevalence of Emphysema in Muğla counties (sum of 2008-2009-2010).

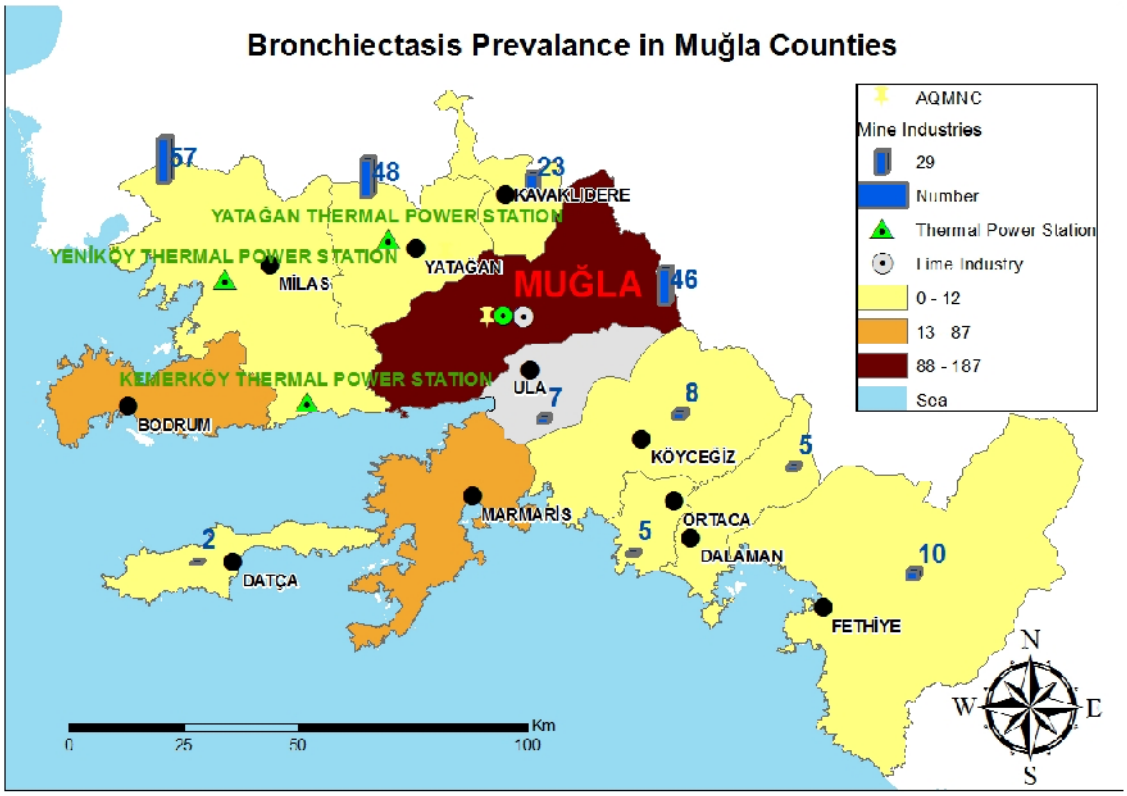



**Figure 4.11** The Bronchiectasis prevalence in Muğla counties (sum of 2008-2009-2010).

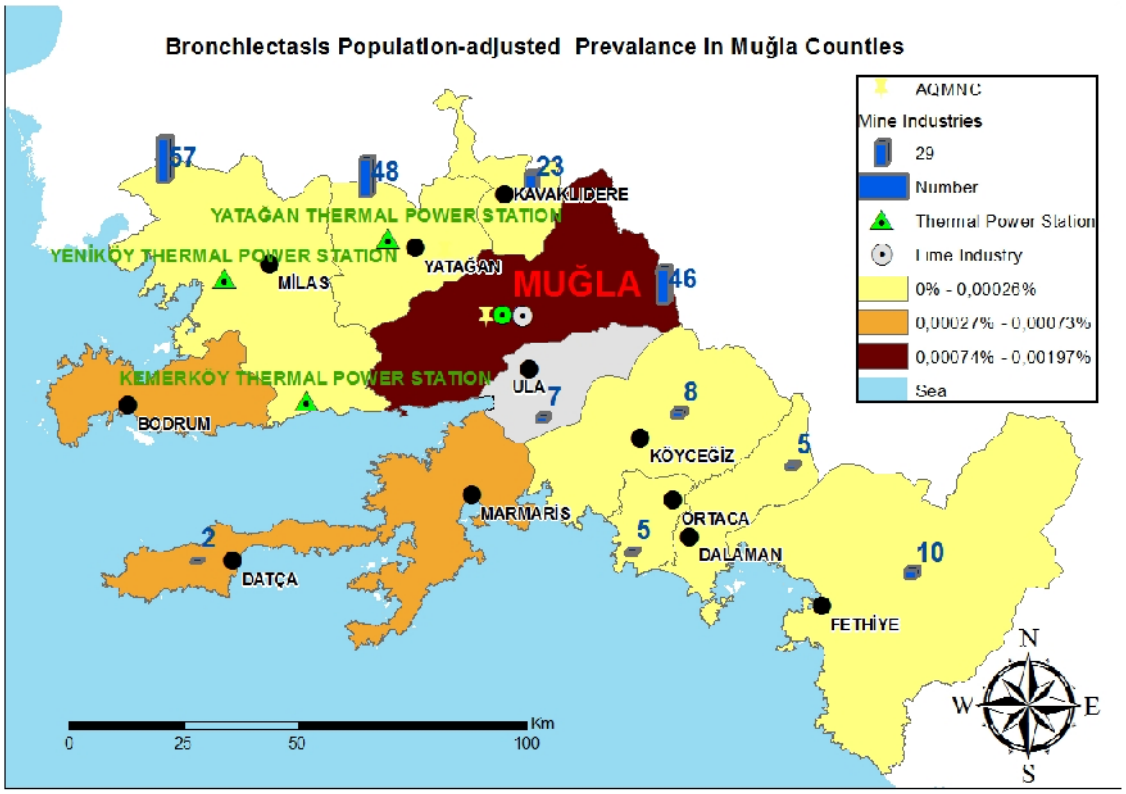



**Figure 4.12** Population-adjusted prevalence of Bronchiectasis in Muğla counties (sum of 2008-2009-2010).

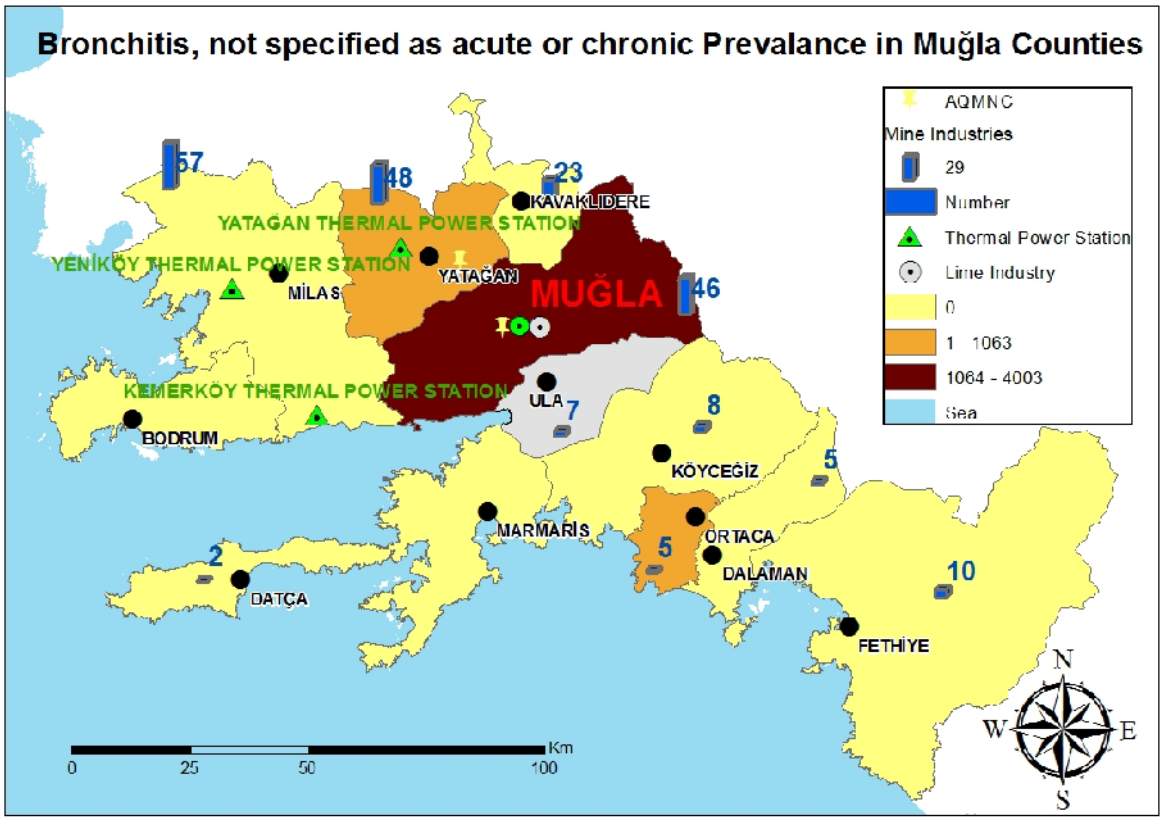



**Figure 4.13** Bronchitis not specified as acute or chronic prevalence in Muğla counties (sum of 2008-2009-2010).

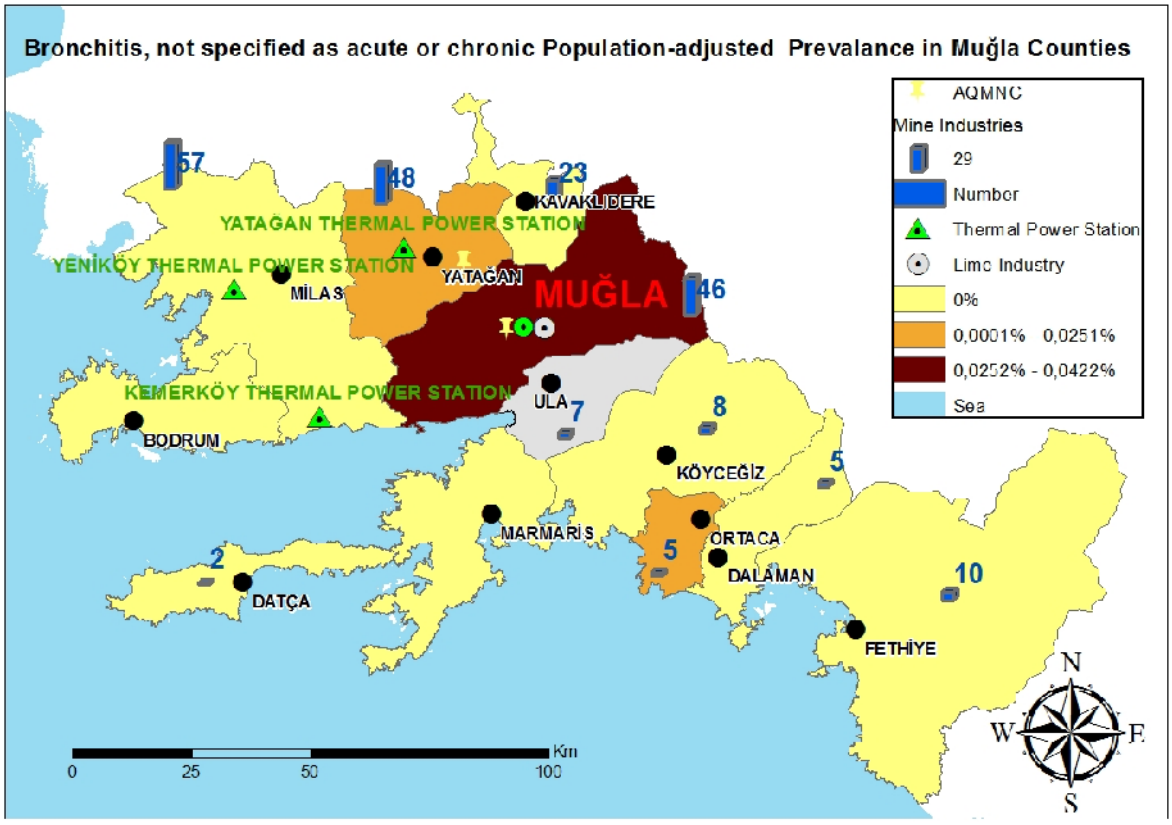



**Figure 4.14** Population-adjusted prevalence of Bronchitis not specified as acute or chronic in Muğla counties (sum of 2008-2009-2010).

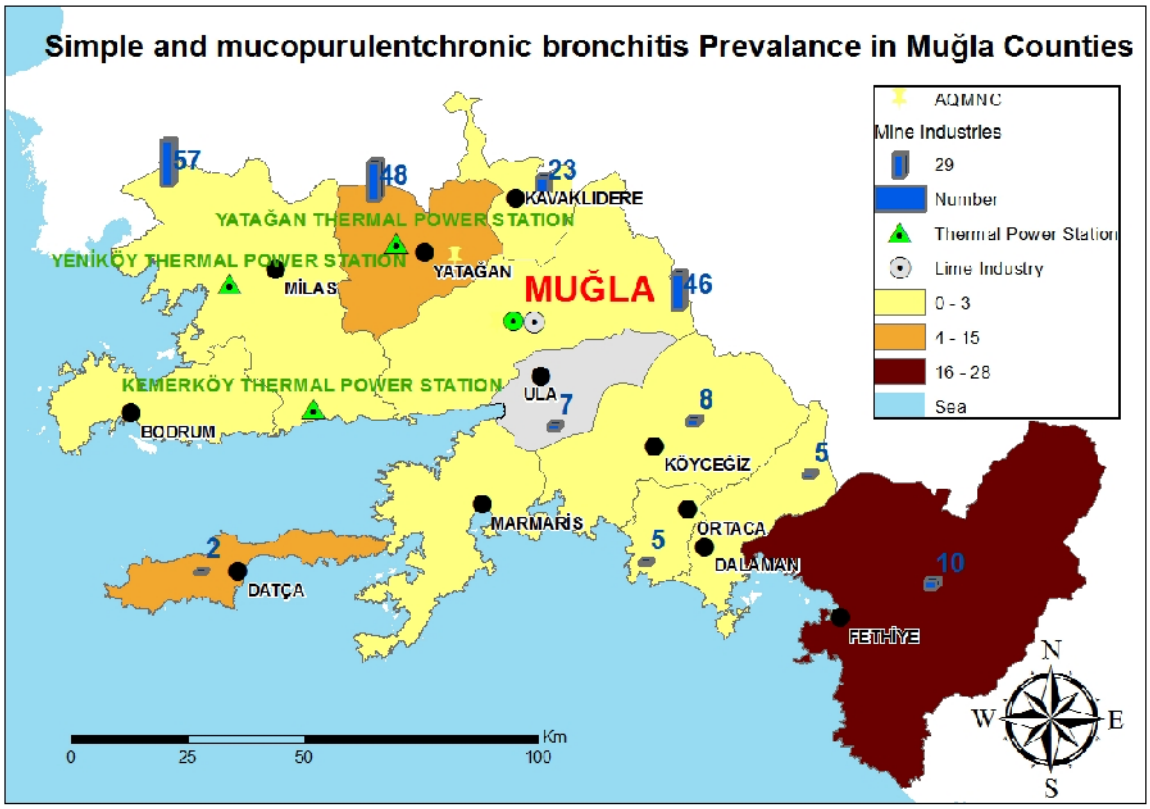



**Figure 4.15** Mucopurulent Chronic Bronchitis prevalence in Muğla counties (sum of 2008-2009-2010).

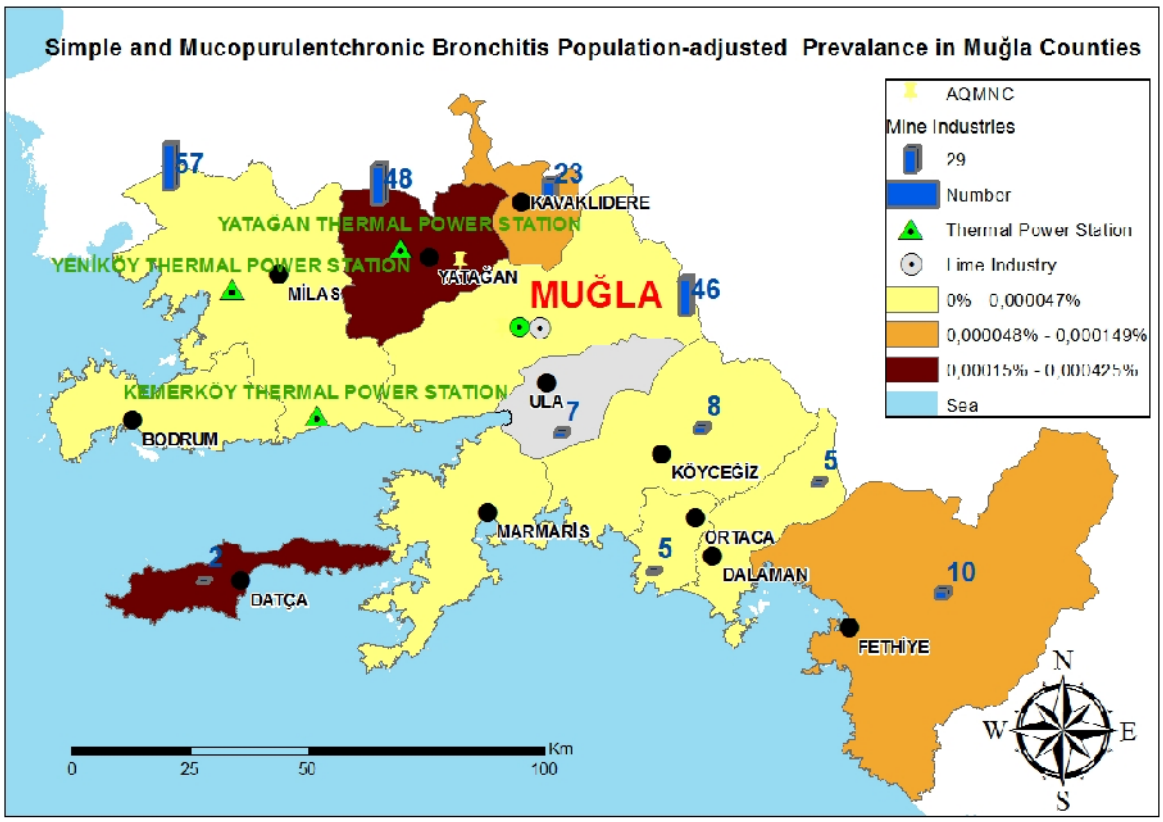



**Figure 4.16** Population-adjusted prevalence of Mucopurulent Chronic Bronchitis in Muğla counties (sum of 2008-2009-2010).

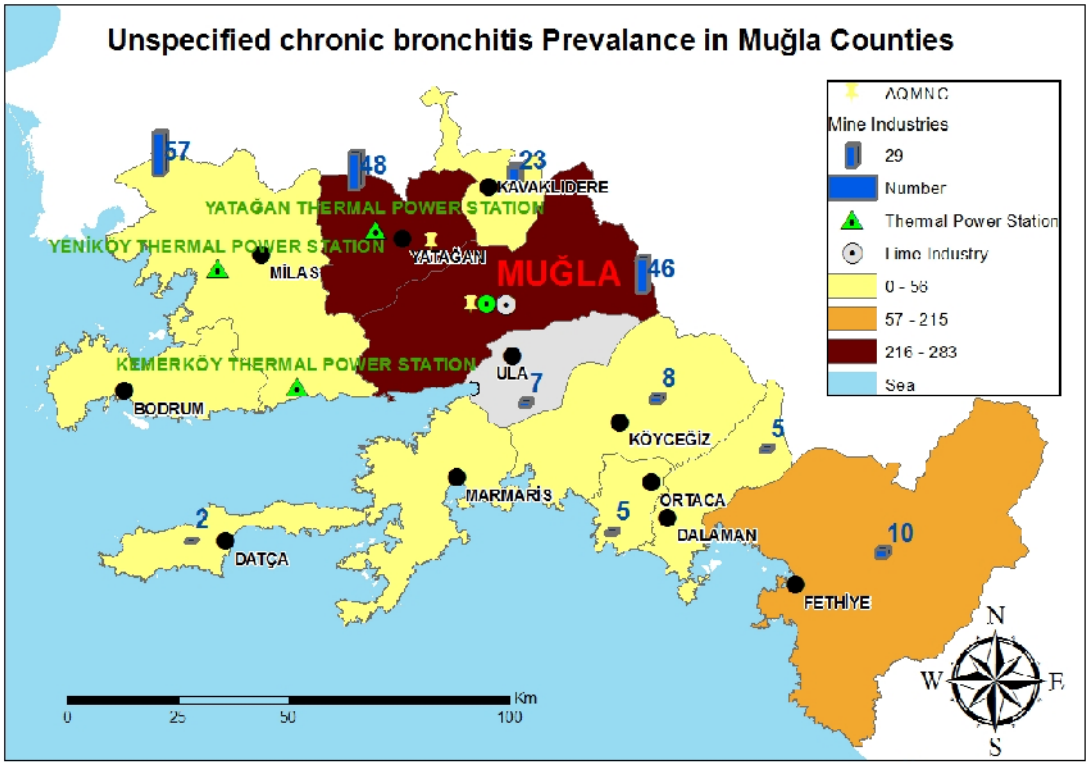



**Figure 4.17** Unspecified Chronic Bronchitis prevalence in Muğla counties (sum of 2008-2009-2010).

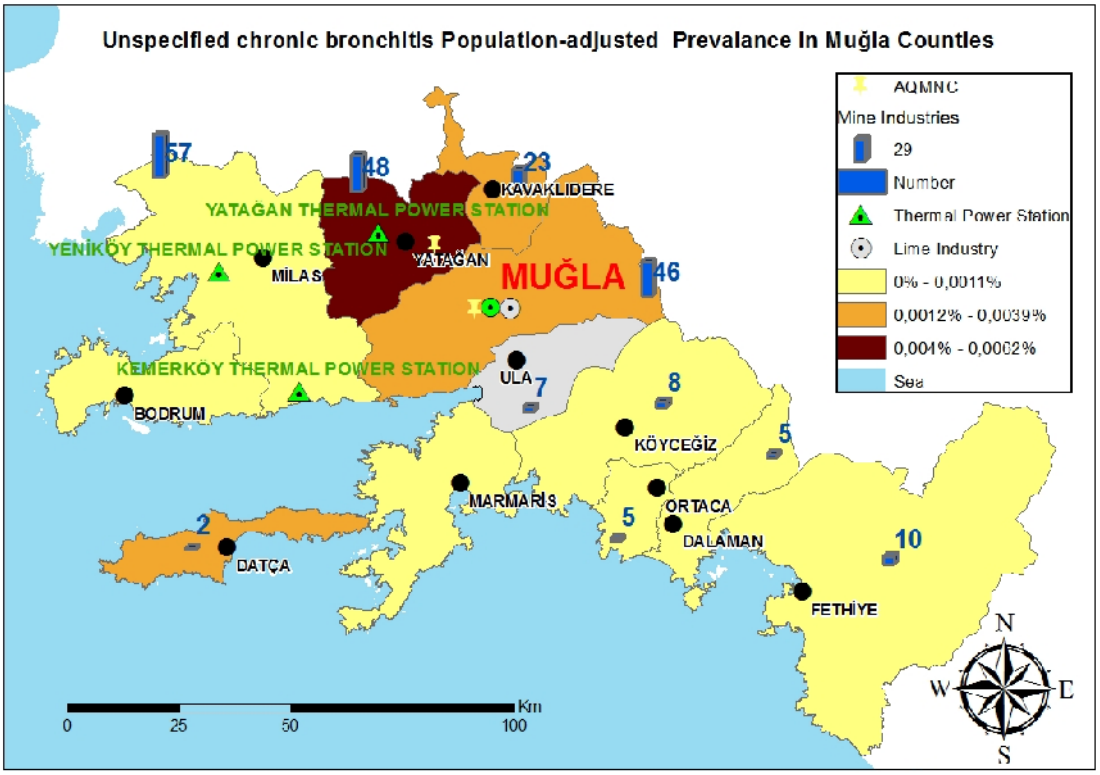



**Figure 4.18** Population-adjusted prevalence of Unspecified Chronic Bronchitis in Muğla counties (sum of 2008-2009-2010).

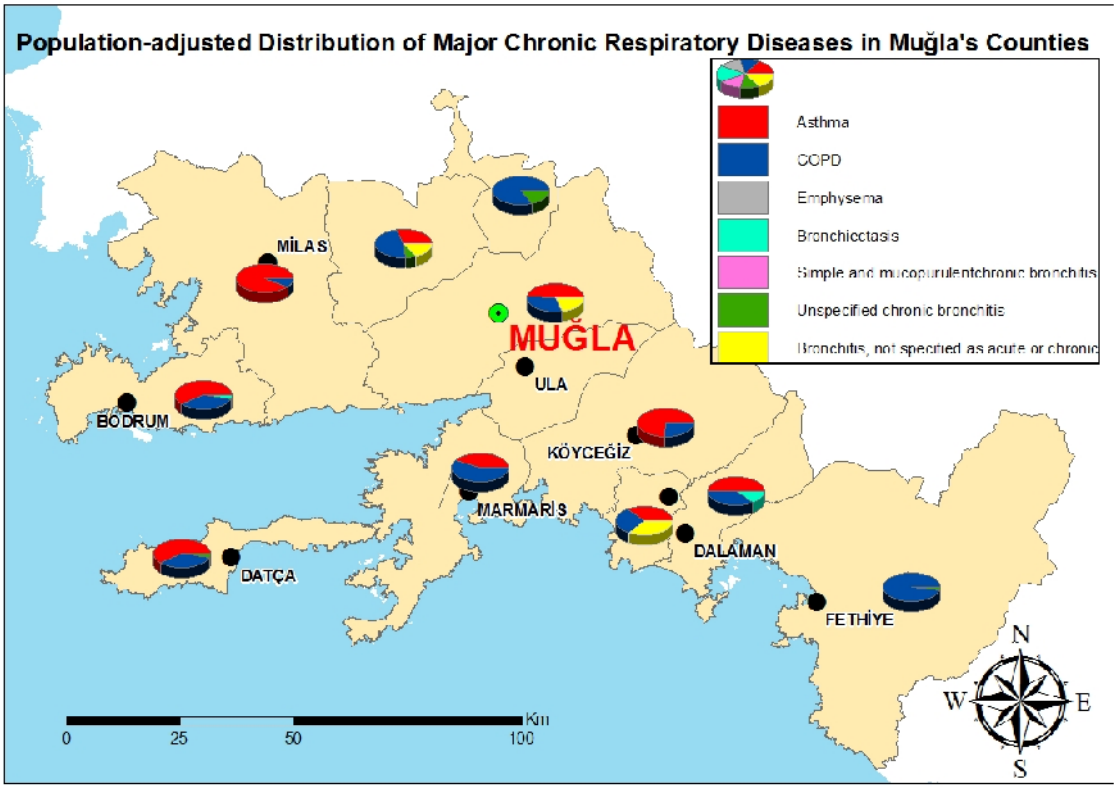



**Figure 4.19** Population-adjusted distribution of major Chronic Respiratory Diseases in Muğla's counties.

## 4.2 ANSWERS OF QUESTIONS IN 3.1.4 AND RESULTS AND DISCUSSIONS OF LIMITATIONS AND POTENTIAL CONFOUNDING FACTORS IN THE WORK

The Muğla case work to bridge the gap between air criteria air pollutants and health effects had a goal to answer the below compromised questions to answer, unfortunately it was not possible to find out the exact answers to these questions in this thesis, but some answers and contributions are given extracted during this research work in Muğla GARD. The answers are usually for more than one question at the same time so they have been given and discussed separately, but not following the specific question [20, 22].

1. How does our understanding of the health effects of air pollutants (singly or in mixtures) help identify pollutants that can be linked to sources the control of which would provide maximal health benefits? (overarching theme)
2. How reliable are methods (measurements and models) and approaches (epidemiological and toxicological) for studying and quantifying the links between air pollutants (species and or sources) and adverse health effects?
3. How do relevant pollutant properties vary in space and time from sources and in ambient air? What are the implications of these variations for population exposure?

4. What advances have been made in understanding the relationships between exposure, both spatially and temporally, and estimates of dose that tie to health outcomes?
5. Are patterns emerging that relate component(s) of air pollution and/or source types to mechanisms? What is the status of identifying and measuring biomarkers of exposure and/or adverse health effects from air pollution?
6. Who are the susceptible populations? What drives different susceptibilities to the same or different air pollutants? Are there susceptibility traits associated with specific health outcomes that are common among the subpopulations?

    a. Susceptibility criteria should be evaluated for each patient according to medical history, anamnesis.
    b. Detailed pedigrees should be drawn for each patient to assess genetic and environmental contribution to the disease.
    c. Susceptibility genes such as GSTs, CYPs, NATs should be genotyped for personalized therapies.
    d. Drug-metabolizing enzyme polymorphisms; Phase I and Phase II drug metabolism; NAT2; G6PD; Exposure assessment;TPMT, CYP2D6, NQO1 and PON genes can be considered more specifically.
    e. The patients' prognosis should be followed by routine and detailed progress and course reportings done by phone calls.

7. What roles do confounding or other factors have in increasing, decreasing, or obscuring attribution of the true health effects from ambient air pollutants?
8. Do actions taken to improve air quality result in reduced ambient concentrations of relevant pollutants, exposure, and health effects? Have we encountered unintended consequences?
9. What are the policy implications of our improved understanding of the source to health effect paradigm?

Confounding factors during the collection of pollutant data and evaluation of the data:

The air criteria pollutant data are collected from two stations and available freely in an easily downloadable format but still requires a deep evaluation from an experts point of view who is in charge of these measurements like me. I am in charge of every detail related to the collection of these data:

1. I was a member of GARD
2. I am in charge of these two stations' maintenance.
3. I am following the contributing factors (factories, facilities mentioned and drawn partly in many of the GIS maps.) to these pollutants.

The data obtained and the way they are obtained have many controversial discussions like [1, 2, 7, 20, 22]:

1. The data for Muğla's air pollution is only for two of the air criteria pollutants.

2. And only two stations collect this data.

3. Muğla station’s place is not suitable for such data collection as centered in a sink place confusing the data collection and evaluations (Figure is for the photographs of the place).

4. The limit value evaluations and average value determinations are done from a 24 hourly basis which is confounding at the end, because the exposure and accumulation of the effects is not an average of events; if the organism is exposed to a deep pollution even once can be enough to induce many detrimental airway related health effects. So the evaluation of each fluctuation in these pollutants is very important and the awareness of each contributor for these fluctuations should be addressed and discussed as given in Figures below.

5. The pollution data to be addressed differently with an expert eye for summer and winter months to understand the confounding differences and variation in data see Figures 4.20 and 4.21.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 29.07.2011 00:00 | 83 | 1 |
| 29.07.2011 01:00 | 76 | 2 |
| 29.07.2011 02:00 | 63 | 2 |
| 29.07.2011 03:00 | 61 | 2 |
| 29.07.2011 04:00 | 57 | 2 |
| 29.07.2011 05:00 | 56 | 2 |
| 29.07.2011 06:00 | 64 | 2 |
| 29.07.2011 07:00 | 77 | 2 |
| 29.07.2011 08:00 | 79 | 2 |
| 29.07.2011 09:00 | 82 | 2 |
| 29.07.2011 10:00 | 88 | 2 |
| 29.07.2011 11:00 | 81 | 2 |
| 29.07.2011 12:00 | 74 | 2 |
| 29.07.2011 13:00 | 57 | 2 |
| 29.07.2011 14:00 | 48 | 10 |
| 29.07.2011 15:00 | 66 | 5 |
| 29.07.2011 16:00 | 70 | 3 |
| 29.07.2011 17:00 | 93 | 2 |
| 29.07.2011 18:00 | 80 | 2 |
| 29.07.2011 19:00 | 73 | 2 |
| 29.07.2011 20:00 | 88 | 2 |
| 29.07.2011 21:00 | 102 | 2 |
| 29.07.2011 22:00 | 103 | 2 |
| 29.07.2011 23:00 | 89 | 2 |

**Figure 4.20** Yatağan station summer month hourly taken $PM_{10}$ and $SO_2$ pollution data. Especially the $SO_2$ values are nearly 0 should be focused.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 30.11.2011 00:00 | 231 | 352 |
| 30.11.2011 01:00 | 228 | 266 |
| 30.11.2011 02:00 | 171 | 224 |
| 30.11.2011 03:00 | 98 | 166 |
| 30.11.2011 04:00 | 109 | 127 |
| 30.11.2011 05:00 | 89 | 168 |
| 30.11.2011 06:00 | 115 | 165 |
| 30.11.2011 07:00 | 107 | 251 |
| 30.11.2011 08:00 | 198 | 372 |
| 30.11.2011 09:00 | 197 | 277 |
| 30.11.2011 10:00 | 136 | 244 |
| 30.11.2011 11:00 | 86 | 253 |
| 30.11.2011 12:00 | 80 | 403 |
| 30.11.2011 13:00 | 77 | 140 |
| 30.11.2011 14:00 | 57 | 72 |
| 30.11.2011 15:00 | 58 | 63 |
| 30.11.2011 16:00 | 68 | 76 |
| 30.11.2011 17:00 | 103 | 108 |
| 30.11.2011 18:00 | 122 | 138 |
| 30.11.2011 19:00 | 122 | 340 |
| 30.11.2011 20:00 | 279 | 419 |
| 30.11.2011 21:00 | 307 | 470 |
| 30.11.2011 22:00 | 320 | 399 |
| 30.11.2011 23:00 | 298 | 281 |

**Figure 4.21** Yatağan station winter month hourly taken $PM_{10}$ and $SO_2$ pollution data. Especially the $SO_2$ values as compared to Figure 4.20 should be focused.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 01.07.2011 00:00 | 31 | 2 |
| 01.07.2011 01:00 | 27 | 5 |
| 01.07.2011 02:00 | 27 | 5 |
| 01.07.2011 03:00 | 27 | 5 |
| 01.07.2011 04:00 | 28 | 3 |
| 01.07.2011 05:00 | 30 | 6 |
| 01.07.2011 06:00 | 35 | 25 |
| 01.07.2011 07:00 | 42 | 17 |
| 01.07.2011 08:00 | 42 | 34 |
| 01.07.2011 09:00 | 48 | 45 |
| 01.07.2011 10:00 | 51 | 35 |
| 01.07.2011 11:00 | 56 | 16 |
| 01.07.2011 12:00 | 55 | 6 |
| 01.07.2011 13:00 | 45 | 7 |
| 01.07.2011 14:00 | 58 | 3 |
| 01.07.2011 15:00 | 55 | 3 |
| 01.07.2011 16:00 | 32 | 3 |
| 01.07.2011 17:00 | 31 | 6 |
| 01.07.2011 18:00 | 47 | 5 |
| 01.07.2011 19:00 | 56 | 6 |
| 01.07.2011 20:00 | 58 | 6 |
| 01.07.2011 21:00 | 61 | 5 |
| 01.07.2011 22:00 | 67 | 6 |
| 01.07.2011 23:00 | 43 | 4 |

**Figure 4.22** Muğla station summer month hourly taken $PM_{10}$ and $SO_2$ pollution data. Especially the $SO_2$ values are much lower than winter data in Figure 4.23 should be focused.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 03.12.2011 00:00 | 278 | 191 |
| 03.12.2011 01:00 | 228 | 177 |
| 03.12.2011 02:00 | 219 | 127 |
| 03.12.2011 03:00 | 157 | 118 |
| 03.12.2011 04:00 | 143 | 99 |
| 03.12.2011 05:00 | 142 | 87 |
| 03.12.2011 06:00 | 143 | 113 |
| 03.12.2011 07:00 | 242 | 153 |
| 03.12.2011 08:00 | 237 | 160 |
| 03.12.2011 09:00 | 242 | 441 |
| 03.12.2011 10:00 | 345 | 408 |
| 03.12.2011 11:00 | 461 | 216 |
| 03.12.2011 12:00 | 185 | 87 |
| 03.12.2011 13:00 | 60 | 70 |
| 03.12.2011 14:00 | 52 | 63 |
| 03.12.2011 15:00 | 52 | 96 |
| 03.12.2011 16:00 | 61 | 207 |
| 03.12.2011 17:00 | 184 | 382 |
| 03.12.2011 18:00 | 479 | 313 |
| 03.12.2011 19:00 | 539 | 288 |
| 03.12.2011 20:00 | 576 | 211 |
| 03.12.2011 21:00 | 294 | 183 |
| 03.12.2011 22:00 | 219 | 124 |
| 03.12.2011 23:00 | 236 | 99 |

**Figure 4.23** Muğla station winter month hourly taken $PM_{10}$ and $SO_2$ pollution data. The much higher $PM_{10}$ and $SO_2$ values as compared to Figure 4.22 should be focused.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 25.01.2011 00:00 | 30 | 23 |
| 25.01.2011 01:00 | 51 | 19 |
| 25.01.2011 02:00 | 15 | 17 |
| 25.01.2011 03:00 | 2 | 15 |
| 25.01.2011 04:00 | 2 | 13 |
| 25.01.2011 05:00 | 1 | 12 |
| 25.01.2011 06:00 | 1 | 12 |
| 25.01.2011 07:00 | 36 | 12 |
| 25.01.2011 08:00 | 48 | 12 |
| 25.01.2011 09:00 | 67 | 13 |
| 25.01.2011 10:00 | 32 | 14 |
| 25.01.2011 11:00 | 11 | 17 |
| 25.01.2011 12:00 | 5 | 29 |
| 25.01.2011 13:00 | 3 | 43 |
| 25.01.2011 14:00 | 5 | 25 |
| 25.01.2011 15:00 | 18 | 28 |
| 25.01.2011 16:00 | 8 | 17 |
| 25.01.2011 17:00 | 24 | 14 |
| 25.01.2011 18:00 | 35 | 13 |
| 25.01.2011 19:00 | 63 | 11 |
| 25.01.2011 20:00 | 34 | 11 |
| 25.01.2011 21:00 | 74 | 10 |
| 25.01.2011 22:00 | 44 | 10 |
| 25.01.2011 23:00 | 53 | 11 |

**Figure 4.24** During snowy days the low $PM_{10}$ and $SO_2$ data are focused.

| Tarih | PM10 | SO2 |
|---|---|---|
| | µg/m³ | µg/m³ |
| 01.06.2011 00:00 | 52 | 7 |
| 02.06.2011 00:00 | 54 | 4 |
| 03.06.2011 00:00 | 65 | 5 |
| 04.06.2011 00:00 | | |
| 05.06.2011 00:00 | | |
| 06.06.2011 00:00 | | |
| 07.06.2011 00:00 | 65 | 14 |
| 08.06.2011 00:00 | 72 | |
| 09.06.2011 00:00 | 87 | 5 |
| 10.06.2011 00:00 | 72 | 22 |
| 11.06.2011 00:00 | 48 | 13 |
| 12.06.2011 00:00 | 41 | 25 |

**Figure 4.25** Yatağan station missing data type confounding factor example cases due to electricity blackout.

**Table 4.5** Yatağan station erranous data collection.

| Collection Date | $PM_{10}$ | $SO_2$ |
|---|---|---|
| 07.11.2010 | 40 | 78 |
| 08.11.2010 | -4976 | -5394 |
| 09.11.2010 | -3733 | -5366 |
| 10.11.2010 | 11 | 55 |
| 11.11.2010 | 7 | 43 |

| Tarih | PM10 | SO2 | Hava Sýicakligi | Ruzgar Yonu | Ruzgar Hizi |
|---|---|---|---|---|---|
| | µg/m³ | µg/m³ | °C | Derece | m/s |
| 27.01.2011 00:00 | 92 | 93 | 13,6 | 26 | 0,8 |
| 27.01.2011 01:00 | 120 | 85 | 13,6 | 136 | 0,6 |
| 27.01.2011 02:00 | 93 | 76 | 13,5 | 126 | 0,6 |
| 27.01.2011 03:00 | 76 | 47 | 13,4 | 130 | 0,8 |
| 27.01.2011 04:00 | 26 | 29 | 13,3 | 123 | 1,3 |
| 27.01.2011 05:00 | 30 | 32 | 13,2 | 88 | 1,8 |
| 27.01.2011 06:00 | 30 | 156 | 13,2 | 128 | 1,9 |
| 27.01.2011 07:00 | 59 | 368 | 13,2 | 126 | 2,0 |
| 27.01.2011 08:00 | 113 | 194 | 13,2 | 131 | 2,0 |
| 27.01.2011 09:00 | 61 | 101 | 13,2 | 126 | 2,3 |
| 27.01.2011 10:00 | 56 | 231 | 13,3 | 95 | 3,5 |
| 27.01.2011 11:00 | 75 | 169 | 14,2 | 106 | 2,9 |

**Figure 4.26** The effect of wind speed (when it is low) on $PM_{10}$ ve $SO_2$ hourly values.

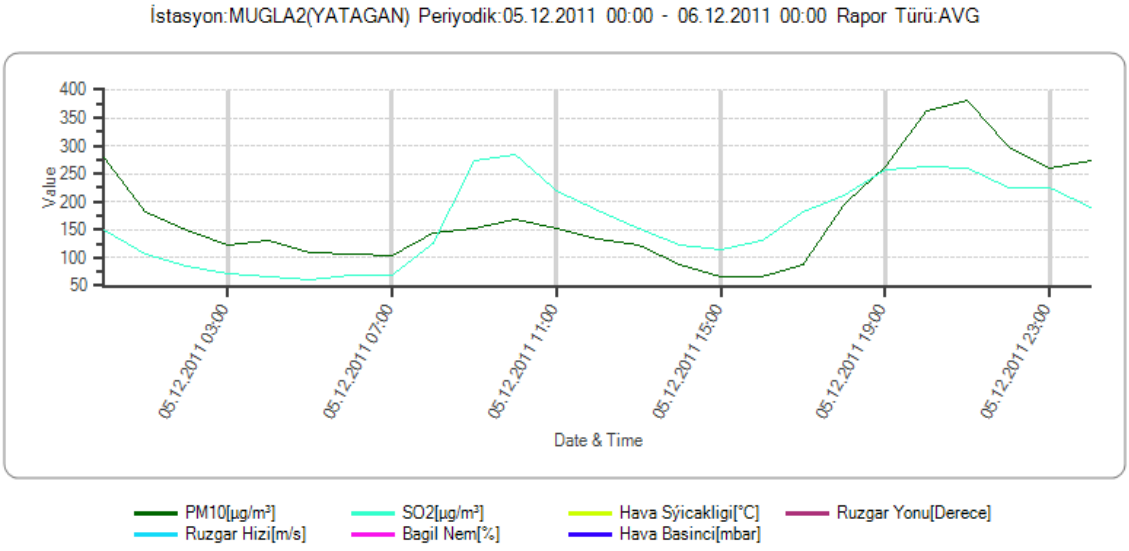



**Figure 4.27** The effect of coal burning hours on $PM_{10}$ ve $SO_2$ values.

T.C.
MUĞLA VALİLİĞİ
İL SAĞLIK MÜDÜRLÜĞÜ

**Sayı** :B.104.İSM.4.48.08.- 212.02.01- 470 -9277 26.04.2011
**Konu:** Türkiye KOAH Önleme ve Kontrol Programı Hk. Bilgi Talebi

ÇEVRE VE ORMAN İL MÜDÜRLÜĞÜ'NE

MUĞLA

**İlgi: 20.04.2011 tarih ve 703–1887 sayılı yazınız.**

İlgi sayılı yazınıza istinaden "Hava Kirliliği ve Sağlık Bağlantısını Sorgulamada Muğla İli Kronik Hava Yolu Hastalıkları Örneği" başlıklı çalışmanızla ilgili olarak, talep etmiş olduğunuz Muğla İline ait Kronik Hava Yolu Hastalıklarının ilçeler bazında envanterinin sayfa dökümünün çok uzun olması sebebi ile il GARD kurulu üyesi Kimya Müh.Ekrem Yazıcıoğlu'na elektronik ortamda ekrem20@yahoo.com adresine gönderilmesi uygun görülmüştür.

Bilgilerinize arz ederim.

**Dr. İskender GENCER**
**Sağlık Müdürü**

T.C.
MUĞLA VALİLİĞİ
İL SAĞLIK MÜDÜRLÜĞÜ

**Sayı:** B.104.İSM.4.48.00.08.- 212.02.01-11-25-2335 03.11.2011
**Konu:** Türkiye KHH Önleme ve
Kontrol Programı

İL ÇEVRE VE ORMAN MÜDÜRLÜĞÜ'NE
MUĞLA

**İlgi:** Sağlık Bakanlığı Temel Sağlık Hizmetleri Genel Müdürlüğü'nün 29.06.2009 tarihli ve 19497 (2009/39) sayılı Genelgesi.

Dünya Sağlık Örgütü'nün kronik solunum hastalıklarından kaynaklanan ölümleri azaltmak amacıyla hayata geçirdiği proje (GARD- Global Alliance Against Chronic Respiratory Diseases-Kronik Solunum Hastalıklarına Karşı Küresel Birlik) kapsamında hazırlanan "Türkiye Kronik Hava Yolu Hastalıklarını (Astım-KOAH) Önleme ve Kontrol Programı (2009–2013) Eylem Planı" uygulamaya konulmuş olup çalışmalarına devam etmektedir.

İlgi sayılı genelge ile eylem planında yer alan aktivitelerin yerine getirilmesi, desteklenmesi ve koordinasyonun sağlanması için İl Kurulumuz 11.11.2010 tarih ve 602–24509 sayılı Valilik oluru ile oluşturulmuştur. Kurulumuzda halen görev yapmakta olan Kimya Mühendisi Ekrem Yazıcıoğlu'nun yerine GARD İl Kurul kadrosunda görev almak üzere kurumumuzda konuyla ilgili olarak çalışan ve deneyimli personelden belirlenecek bir kişinin adı, soyadı, ünvanı ve iletişim bilgilerinin (cep telefonu, elektronik posta adresi) **04.11.2011** pazartesi günü mesai bitimine kadar bildirilmesi hususunda;

Gereğini arz ederim.

Dr. İskender GENCER
İl Sağlık Müdürü

Ayrıntılı Bilgi İçin: Dr. Ö. ONKAŞ Şb. Md
Elektronik Posta: muglaruh@gmail.com

Muğla İl Sağlık Müdürlüğü
Ruh Sağlığı ve Sosyal Hastalıklar Şubesi
Bulaşıcı Olmayan Hastalıklar ve Kronik Durumlar Birimi
**Telefon:** (0252) 214 1105/1128 **Belge Geçer:** (0252) 214 3685

T.C.
MUĞLA VALİLİĞİ
İl Çevre ve Orman Müdürlüğü

Sayı : B.18.0.İÇO.2.48.00.02/900-1919
Konu: Ekrem YAZICIOĞLU

İL SAĞLIK MÜDÜRLÜĞÜNE
MUĞLA

İl Müdürlüğümüz Çevre Yönetimi Şube Müdürlüğünde Kimya Mühendisi olarak gö yapmakta olan Ekrem YAZICIOĞLU' nun 21/11/2011 tarihli dilekçesi yazımız eki gönderilmektedir.

Bilgilerinizi ve gereğini arz ederim.

Mehmet ŞAHİN
İl Müdür V.

Eki: 1 Dilekçe (1 Sayfa)

İL ÇEVRE VE ORMAN MÜDÜRLÜĞÜ ÇEVRE YÖNETİMİ ŞUBE MÜDÜRLÜĞÜNE
MUĞLA İL SAĞLIK MÜDÜRLÜĞÜNE SUNULMAK ÜZERE

Valilik Makamının 01/03/2011 tarih ve 4378 sayılı olurları ile İlimiz GARD kurulu yürütme kuruluna görevlendirildim, ayrıca Valilik Makamının 13/04/2011 tarih ve 8208 sayılı olurları ile İlimiz GARD komisyonu İl Kuruluna görevlendirildim. Bu kapsamda düzenlenen toplantılara katıldım. Gerekli görüş ve önerilerimi kurulumuza sundum. Ayrıca Kurul Sekreteryası görevini yapan Dr.Öner ÖNKAŞ beye mail yolu ile ilettim.

İl Müdürlüğünüzün 03/11/2011 tarih ve 23375 sayılı İl Çevre ve Orman Müdürlüğüne yazılan yazısı ile benim yerime GARD İl Kurulunda görev almak üzere bu konuyla ilgili çalışan deneyimli personelin iletişim bilgileri istenmiş olup bu yazı üzerine İl Çevre ve Orman Müdürlüğümüzce benim yerime başka personelin isim bilgileri Kurumunuza göndermiştir.

Söz konusu İl Kurulunda şahsımın hangi çalışmasından memnun olunmadığı ve deneyimsiz olduğum kanaatine varılarak görevimin değiştirilmesi hususunda yazı yazıldığının tarafıma Bilgi Edinme Kanunun kapsamında açıklanması hususunu;

Bilgilerinize arz ederim.

Ekrem YAZICIOĞLU
Kimya Mühendisi

**T.C.**
**MUĞLA VALİLİĞİ**
**İL SAĞLIK MÜDÜRLÜĞÜ**

**Sayı :** B.104.İSM.4.48.08 / 212.02.01 / 1651 - 25326 02.12.2011
**Konu:** Ekrem YAZICIOĞLU Hk.

**İL ÇEVRE VE ORMAN MÜDÜRLÜĞÜ'NE**
**MUĞLA**

**İlgi:** 25.11.2011 tarih ve 1919-4882 sayılı yazınız.

İlgi tarihli yazı ile Müdürlüğümüze gönderilen dilekçede Kimya Mühendisi olarak görev yapan Ekrem YAZICIOĞLU GARD İl Kurulunda görev yapmakta iken kendi özel tezi için hasta bilgileri istemiştir. Kendisine hasta bilgileri gönderilmiştir. Ancak bununla yetinmeyip hasta bilgilerinin sınıflandırılması, ingilizce anlamları, hastalık tanımları gibi bilgiler istemeye devam etmiş olup gönderdiği mailler ekte sunulmuştur. Adı geçen şahıs bu konuda gerek mail yoluyla gerek telefonla uyarılmış, bu isteklere devam etmesi halinde GARD İl Kurulundan çıkarılacağı kendisine bildirilmiştir.

Şube Müdürü Doktor Öner ÖNKAŞ'ın, Ruh Sağlığı ve Sosyal Hastalıklar Şubesi'nin yanı sıra başka idari görevler de yaptığından dolayı kişisel taleplere zaman ayırması mümkün değildir.

Bu şartlarda Ekrem YAZICIOĞLU'nun GARD İl Kurulu çalışmalarında verimli olamayacağı anlaşılmış olup yerine GARD İl Kurulu kadrosunda görev almak üzere kurumunuzda konuyla ilgili olarak çalışan başka bir personel talebinde bulunulmuştur.

Bilgilerinize arz ederim.

**Dr. İskender GENCER**
**Sağlık Müdürü**

**Ek:** Yazı(4 Adet)

**iyi günler-rica** 1 Hide Details

FROM: ekrem yazic oglu Tuesday, May 24, 20'1 10:52 AM

TO: onerorkas@gmail.com

İyi günler Öner Bey,
öncelikle kolay ge sin bana gönderd ğiniz veriler için çck teşekkürler onlardan
bazılarında 2008-2009 yılları yok sanırım sizde de yok. size eğer şu şekilde
daha basi: bir taslak halinde ilçe bazlı hasta sayıları varsa onu liste halinde
sadece sayılarını oluşturduysanız gönderebilirseniz çok sevinirim. Taslak örneği
ekte gönderiyorum ben. kolay gelsin iyi çalışmalar.

Ekrem Yazicioglu

Sayg lar mla..
Best Regards,
C* ----------

1 Attached files | 10KB

Genel İlçe ba

Download

**Fw: iyi günler** Hide Details

FROM: ekrem yazicioglu Tuesday, May 31, 2011 9:40 AM

TO: onerorkas@gmail.com

Öner Bey merhabalar kolay gelsin,
size bazı sorularım olacaktı yardımcı olabilirseniz çok sevinirim.
bildiğiniz üzere bir teze başladım bazı bilgilere ihtiyacım oluyor. sizden ricam

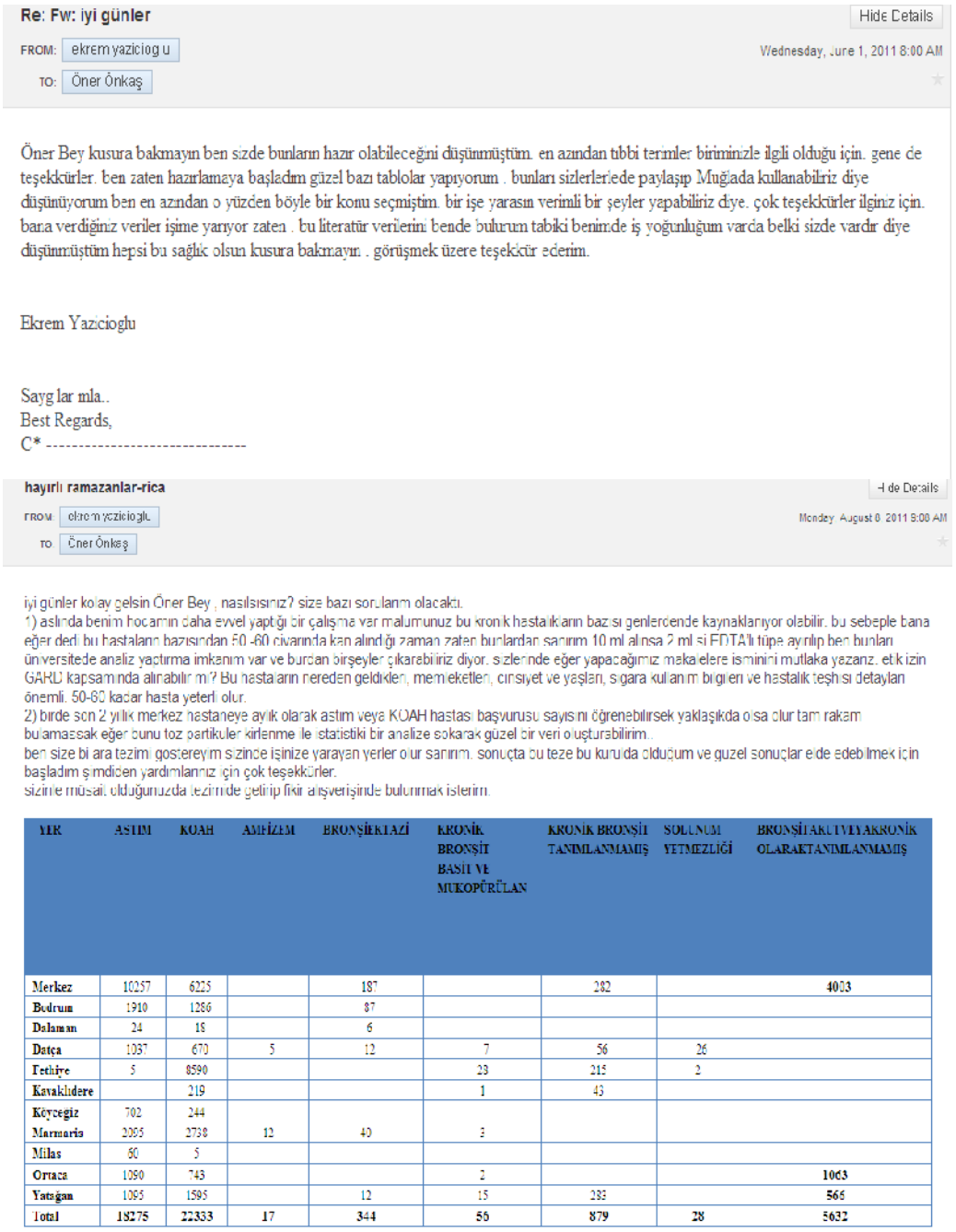
sizde şu aşağıdaki hastalıkların ingilizce karşılıkları ve klinik ve
epidemiyolojik bilgilerin bana yollayabilirseniz çok seviririm. kolay gelsin
iyi çalışmalar. verileri ingilizcede gönderebilirsiniz hocam farketmez. tezimi
ingilizce yazıyorum çünkü. ingilizce olmasa türkçe olsa da olur. önemli olan
literatüre koymam açısından sizde olabilecek kısa kısa en azından 1 er sayfalık
veriler yeterli olacaktır teşekkürler.

saygılarımla.

ASTIM,
KOAH AMFİZEM BRONŞİEKTAZİ
İNTERSİTİSYEL AKCİĞER HASTALIKLARI,
DİĞER KRONİK BRONŞİT,
BASİT VE MUKOPÜRÜLAN KRONİK BRONŞİT,
TANIMLANMAMIŞ SOLUNUM YETMEZLİĞİ HAVAYOLU HASTALIĞI
TANIMLANMIŞ ORGANİK TOZLARA BAĞLI SOLUNUM HASTALIKLARI SOLUNAN
KİMYASAL MADDE GAZ,DUMAN VEYA BUHARLARA BAĞLI ASBESTOZİS BRONŞİT, AKUT VEYA
KRONİK OLARAK TANIMLANMAMIŞ

Ekrem Yazicioglu

Sayg lar mla.
Best Regards,
C* ----------



**Re: Fw: iyi günler** Hide Details

FROM: ekrem yazicioglu Wednesday, June 1, 2011 8:00 AM

TO: Öner Önkaş

Öner Bey kusura bakmayın ben sizde bunların hazır olabileceğini düşünmüştüm. en azından tıbbi terimler biriminizle ilgili olduğu için. gene de teşekkürler. ben zaten hazırlamaya başladım güzel bazı tablolar yapıyorum . bunları sizlerlerlede paylaşıp Muğlada kullanabiliriz diye düşünüyorum ben en azından o yüzden böyle bir konu seçmiştim. bir işe yarasın verimli bir şeyler yapabiliriz diye. çok teşekkürler ilginiz için. bana verdiğiniz veriler işime yarıyor zaten . bu literatür verilerini bende bulurum tabiki benimde iş yoğunluğum varda belki sizde vardır diye düşünmüştüm hepsi bu sağlık olsun kusura bakmayın . görüşmek üzere teşekkür ederim.

Ekrem Yazicioglu

Saygılar mla..
Best Regards,
C* ----------

**hayırlı ramazanlar-rica** Hide Details

FROM: ekrem yazicioglu Monday, August 8, 2011 9:00 AM

TO: Öner Önkaş

iyi günler kolay gelsin Öner Bey , nasılsınız? size bazı sorularım olacaktı.
1) aslında benim hocamın daha evvel yaptığı bir çalışma var malumunuz bu kronik hastalıkların bazısı genlerdende kaynaklanıyor olabilir. bu sebeple bana eğer dedi bu hastaların bazısından 50 -60 civarında kan alındığı zaman zaten bunlardan sarımın 10 ml alınsa 2 ml si EDTA'lı tüpe ayrılıp ben bunları üniversitede analiz yaptırma imkanım var ve burdan birşeyler çıkarabiliriz diyor. sizlerinde eğer yapacağımız makalelere isminini mutlaka yazarız. etik izin GARD kapsamında alınabilir mi? Bu hastaların nereden geldikleri, memleketleri, cinsiyet ve yaşları, sigara kullanım bilgileri ve hastalık teşhisi detayları önemli. 50-60 kadar hasta yeterli olur.
2) birde son 2 yıllık merkez hastaneye aylık olarak astım veya KOAH hastası başvurusu sayısını öğrenebilirsek yaklaşıkda olsa olur tam rakam bulamassak eğer bunu toz partikuler kirlenme ile istatistiki bir analize sokarak güzel bir veri oluşturabilirim..
ben size bi ara tezimi göstereyim sizinde işinize yarayan yerler olur sanırım. sonuçta bu teze bu kurulda olduğum ve güzel sonuçlar elde edebilmek için başladım şimdiden yardımlarınız için çok teşekkürler.
sizinle müsait olduğunuzda tezimde gelirip fikir alışverişinde bulunmak isterim.

| YER | ASTIM | KOAH | AMFİZEM | BRONŞİEKTAZİ | KRONİK BRONŞİT BASİT VE MUKOPÜRÜLAN | KRONİK BRONŞİT TANIMLANMAMIŞ | SOLUNUM YETMEZLİĞİ | BRONŞİT AKUT VEYA KRONİK OLARAK TANIMLANMAMIŞ |
|---|---|---|---|---|---|---|---|---|
| Merkez | 10257 | 6225 | | 187 | | 282 | | 4003 |
| Bodrum | 1910 | 1286 | | 87 | | | | |
| Dalaman | 24 | 18 | | 6 | | | | |
| Datça | 1087 | 670 | 5 | 12 | 7 | 56 | 26 | |
| Fethiye | 5 | 8590 | | | 23 | 215 | 2 | |
| Kavaklıdere | | 219 | | | 1 | 43 | | |
| Köyceğiz | 702 | 244 | | | | | | |
| Marmaris | 2065 | 2738 | 12 | 40 | 3 | | | |
| Milas | 60 | 5 | | | | | | |
| Ortaca | 1090 | 743 | | | 2 | | | 1063 |
| Yatağan | 1065 | 1595 | | 12 | 15 | 283 | | 565 |
| Total | 18275 | 22333 | 17 | 344 | 55 | 879 | 28 | 5632 |

**Figure 4.28** Confounding factor evidences mentioned in Part 1.1.

# CHAPTER 5

# CONCLUSION

Creating effective, evidence-based policy requires linking health and economic endpoints back to the sources, so that preventive policy options and recommendations can be tailored to address emissions' sources in order of their contribution to the air pollution problem. The research has five interconnectedcomponents:

• air quality, meteorology and emissions data analysis
• epidemiological studies of health effects in Muğla city and counties
• air pollution exposure assessment
• health impact assessment
• preventative policy discussion

This thesis presents the results of a pilot study covering Muğla city and its counties.

Those who suffer from a disease should become experts of their own disease. An association of patients could be very effective in lobbying government to put more energy and resources into research and education in health issues. The patient–doctor relationship should be a partnership. Thinking in terms of partnership means that the next step will be to engage the awareness of the patient who experiences a condition for 365 days a year, as opposed to the doctor who sees it for just a few hours a year. The doctor should serve as an adviser and researcher who should further evaluate the cues and hints given by the patients.

Air pollution regulation continues to have important implications for public health and environmental welfare, as well as the health of the economy. To be sure, these

critical policy decisions need to be made on a foundation of sound and innovative science.

The questions to be answered are: What is left to do regarding air pollution control, and can we further advance our understanding of air pollution risk and find ways to sustainably protect health and the environment as an environmental engineer working in the field? My position is as a civil servant working for the Ministry of Environment and City Planning at Muğla city. As a member of the GARD in Muğla I have had a chance to focus at the public health problems and underlying mechanisms related. To be a part of the scientific community as an MS thesis student at Fatih University Environmental Engineering department (under the supervision of a molecular biologist and geneticist Assist Prof. İrem Uzonur from Biology Department with many health related projects) and working as a part of decision and policy making, regulatory position gave me the chance to further evaluate the existing gaps between science and governmental communities in the source to health paradigm that is the basic motivation of my thesis. In this thesis I have had the chance to disseminate the scientific facts in the policy making levels that can be furthered with such a preliminary work.

.

# REFERENCES


1. Solomon, Paul A. 2011. “Air pollution and health: bridging the gap from sources to health outcomes.” *Environmental health perspectives* 119(4): a156-7. Available at: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3080947&tool=pmcentrez&rendertype=abstract [Accessed May 16, 2011].

2. Bell, Michelle L et al. 2011. “Environmental health indicators and a case study of air pollution in Latin American cities.” *Environmental research* 111(1): 57-66. Available at: http://www.ncbi.nlm.nih.gov/pubmed/21075365 [Accessed January 30, 2011].

3. Cohen, Aaron J. 2000. “Outdoor Air Pollution and Lung Cancer Exposures to Carcinogens in Outdoor Air.” *Environmental Health* 108 (September 1999): 743-750.

4. Perkins, H.C., Air Pollution, Mc Graw Hill, New York, 1974

5. Derwent, R.G. 1990 *Science of The Total Environment*,Volume 93, 255-262.

6. Nilgün Akbulut Çoban, Türkiye’de Kentlerde Ölçülen Partiküler Madde $PM_{10}$ Konsantrasyonlarının Değerlendirilmesi, Yüksek Lisans Tezi, Hacettepe Üniversitesi, Çevre Mühendisliği Anabilim Dalı, 2009.

7. Tecer, L. H., Alagha, O., Karaca, F., Tuncel, G., and Nilufer Eldes. “Particulate matter (PM (2.5), PM (10-2.5), and PM (10)) and children’s hospital admissions for asthma and respiratory diseases: a bidirectional case-crossover study.” *Journal of toxicology and environmental health. Part A* 71, no. 8 (January 2008): 512-20. http://www.ncbi.nlm.nih.gov/pubmed/18338286.

8. Khardori, Amit. 2000. “Health-Based Standards in the Clean Air Act The Controversy over Peace of Mind.” *Clean Air* (May): 1-57.

9. Smith, K. R. 2002. “Indoor air pollution in developing countries: recommendations for research+.” *Indoor Air* 12(3): 198-207. Available at: http://www.blackwell-synergy.com/links/doi/10.1034%2Fj.1600-0668.2002.01137.x.

10. Vanderoost, R, J Beyer, and N Vermeulen. 2003. “Fish bioaccumulation and biomarkers in environmental risk assessment: a review.” *Environmental Toxicology and Pharmacology* 13(2): 57-149. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1382668902001266.

11. Nebert, D W, and a L Roe. 2001. “Ethnic and genetic differences in metabolism genes and risk of toxicity and cancer.” *The Science of the total environment* 274(1-3): 93-102. Available at: http://www.ncbi.nlm.nih.gov/pubmed/11453308.

12. Global Alliance Against Chronic Respiratory Diseases (GARD): 5th general meeting report, 1-2 June 2010,Toronto, Canada.

13. Laurendi, Giovanna et al. 2011. “Global alliance against chronic respiratory diseases in Italy (GARD-Italy): Strategy and activities.” *Respiratory medicine* (June): 1 - 2. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22024553.

14. Global surveillance, prevention and control of Chronic Respiratory Diseases, A comprehensive approach.

15. Yoshida, T., and Rubin M. T. 2007. “Pathobiology of Cigarette Smoke-Induced Chronic Obstructive Pulmonary Disease.” *North*: 1047-1082.

16. Tzortzaki, E. G., and Siafakas, N. M. “A hypothesis for the initiation of COPD.” *The European respiratory journal : official journal of the European Society for Clinical Respiratory Physiology* 34, no. 2 (August 2009): 310-5. http://www.ncbi.nlm.nih.gov/pubmed/19648516.

17. Cohen, J. and Powderly, W. 2004. “Infectious Diseases. 2nd ed. Mosby (Elsevier),. Chapter 33: Bronchitis, Bronchiectasis, and Cystic Fibrosis.

18. Hueston, W. J. 1997. "Antibiotics: neither cost effective nor ’cough’ effective". *The Journal of Family Practice*, 44 (3): 261–5. PMID 9071245.

19. Yorgancıoğlu, A., N., Yardım, P., Ergün, C., Karlıkaya, A., Kocabaş, D., Mungan, F Yıldız, et al. 2010 “Integration of GARD Turkey national program with other non-communicable diseases plans in Turkey.” *Tüberküloz ve toraks* 58, no. 2: 213-28. http://www.ncbi.nlm.nih.gov/pubmed/20865577.

20. Corporan, E., Adam, Q., Matthew, DeW., Chun, L., Shannon, S., Yongxin, Z., Sung, L., et al. 2008 “Effect of Meteorological Parameters on Fine and Coarse Particulate Matter Mass Concentration in a Coal-Mining Area in Zonguldak, Turkey.” *Journal of the Air & Waste Management Association* 58, no. 4: 543-552. http://secure.awma.org/onlinelibrary/doihandler.aspx?doicode=10.3155-1047-3289.58.4.543.

21. Ates, N. A.,Yildirim, H., Ercan, B., Saritas, E., Ünlü, A. and Atik, U. “GSTP1 as increased risk factors for asthma.” *Respirology* 493-498.

22. Karaca, F., Alagha, O., Ertürk, F., Yılmaz, Y. Z. and Özkara, Y. 2008 “Seasonal Variation of Source Contributions to Atmospheric Fine and Coarse Particles at Suburban Area in Istanbul, Turkey.” *Environmental Engineering Science* 25, no. 5: 767-782. http://www.liebertonline.com/doi/abs/10.1089/ees.2007.0170.