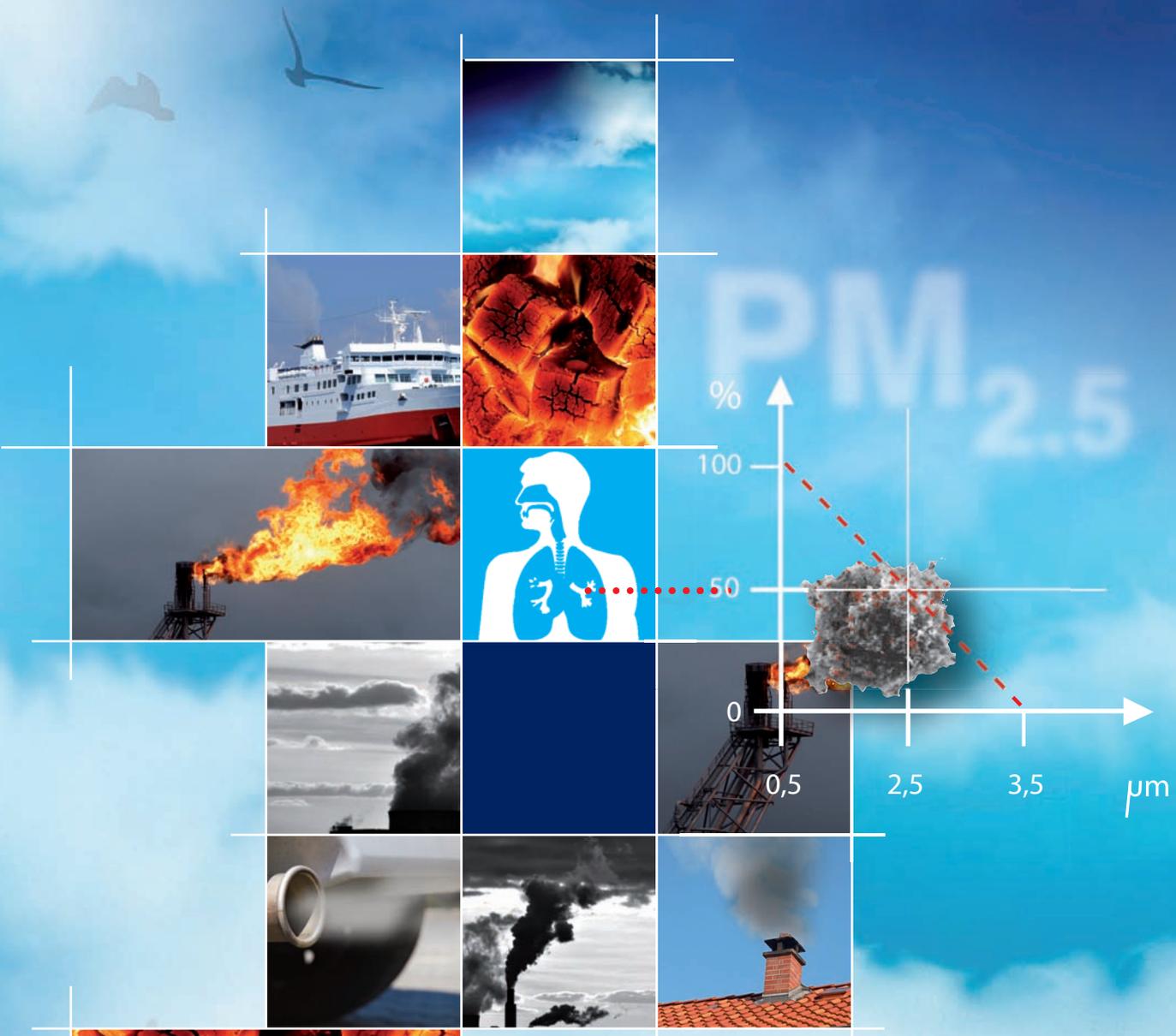




World Health
Organization

REGIONAL OFFICE FOR Europe



HEALTH EFFECTS OF **BLACK CARBON**



**World Health
Organization**

REGIONAL OFFICE FOR **Europe**

Health effects of black carbon

By:

Nicole AH Janssen, Miriam E Gerlofs-Nijland, Timo Lanki,
Raimo O Salonen, Flemming Cassee, Gerard Hoek,
Paul Fischer, Bert Brunekreef, Michal Krzyzanowski

ABSTRACT

This report presents the results of a systematic review of evidence of the health effects of black carbon (BC). Short-term epidemiological studies provide sufficient evidence of an association of daily variations in BC concentrations with short-term changes in health (all-cause and cardiovascular mortality, and cardiopulmonary hospital admissions). Cohort studies provide sufficient evidence of associations of all-cause and cardiopulmonary mortality with long-term average BC exposure. Studies of short-term health effects suggest that BC is a better indicator of harmful particulate substances from combustion sources (especially traffic) than undifferentiated particulate matter (PM) mass, but the evidence for the relative strength of association from long-term studies is inconclusive. The review of the results of all available toxicological studies suggested that BC may not be a major directly toxic component of fine PM, but it may operate as a universal carrier of a wide variety of chemicals of varying toxicity to the lungs, the body's major defence cells and possibly the systemic blood circulation. A reduction in exposure to PM_{2.5} containing BC and other combustion-related PM material for which BC is an indirect indicator should lead to a reduction in the health effects associated with PM.

Keywords

AIR POLLUTION – adverse effects
SOOT – toxicity
INHALATION EXPOSURE – adverse effects
PARTICULATE MATTER – analysis
RISK ASSESSMENT

ISBN: 978 92 890 0265 3

Address requests about publications of the WHO Regional Office for Europe to:

Publications
WHO Regional Office for Europe
Scherfigsvej 8
DK-2100 Copenhagen Ø, Denmark

Alternatively, complete an online request form for documentation, health information, or for permission to quote or translate, on the Regional Office web site (<http://www.euro.who.int/pubrequest>).

© World Health Organization 2012

All rights reserved. The Regional Office for Europe of the World Health Organization welcomes requests for permission to reproduce or translate its publications, in part or in full.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

All reasonable precautions have been taken by the World Health Organization to verify the information contained in this publication. However, the published material is being distributed without warranty of any kind, either express or implied. The responsibility for the interpretation and use of the material lies with the reader. In no event shall the World Health Organization be liable for damages arising from its use. The views expressed by authors, editors, or expert groups do not necessarily represent the decisions or the stated policy of the World Health Organization.

Edited by: Rosemary Bohr. *Cover design:* Dagmar Bengs.

Pictures: axepe, Imaginis, Ingo Bartussek, Jeanette Dietl, Kalle Kolodziej, mozZz, think4photop (Fotolia.com).

Printed by: WarlichDruck RheinAhr GmbH.

CONTENTS

	<i>Page</i>
Acknowledgements.....	iv
Abbreviations.....	v
Executive summary	vii
Introduction.....	1
References	3
1. Metrics used to estimate the exposure to BC in health studies: strengths and weaknesses.....	4
Introduction	4
Measurement methods of the dark component of PM.....	5
Comparison of the optical measurement methods with each other and with more sophisticated methods.....	6
Conclusions	10
References	11
2. Assessment of exposure to BC in epidemiological studies	13
Short-term exposures.....	13
Long-term exposures	16
Conclusions	19
References	20
3. Effects of BC exposure observed in epidemiological studies	23
Results.....	24
Discussion	30
References	33
4. Evidence from toxicology, including human clinical studies	37
Introduction	37
Adverse health effects of BC in the controlled human exposure experiments.....	41
Mechanisms of toxicity	45
Conclusions	46
References	46
Annex 1. Literature search criteria	51
Annex 2. Contributors to the report.....	55
Annex 3. Supplementary material to the review of epidemiological studies	57

Acknowledgements

This report was prepared by the Joint World Health Organization (WHO)/Convention Task Force on Health Aspects of Air Pollution according to the Memorandum of Understanding between the United Nations Economic Commission for Europe and the WHO Regional Office for Europe. The Regional Office thanks the Swiss Federal Office for the Environment for its financial support of the work of the Task Force. The Task Force on Health work is coordinated by the WHO European Centre for Environment and Health, Bonn.



Convention on Long-range Transboundary Air Pollution

Abbreviations

Abs	absorbance
BC	black carbon
BCP	black carbon particles
BS	black smoke
CVD	cardiovascular disease
DE	diesel engine exhaust
EC	elemental carbon
IQR	inter-quartile range
NIOSH	National Institute for Occupational Safety and Health
OC	organic carbon
PAH	polycyclic aromatic hydrocarbons
PM	particulate matter
POM	particulate organic matter
RSS	rice-straw smoke
RR	relative risk
TOR	thermal optical reflectance
TOT	thermal optical transmittance
UFP	ultrafine particles

Executive summary¹

Following decision 2010/2 of the Executive Body for the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/106/Add.1, para 8(b)(i)), the Task Force on Health Aspects of Air Pollution working under the Convention conducted an assessment of the health effects of black carbon (BC) as a component of fine particulate matter (PM_{2.5}). The Task Force's discussion focused on formulating the conclusions presented below, on the basis of the working papers prepared for it and comments received from external reviewers.

BC is an operationally defined term which describes carbon as measured by light absorption. As such, it is not the same as elemental carbon (EC), which is usually monitored with thermal-optical methods. Current measurement methods for BC and EC need to be standardized so as to facilitate comparison between the results of various studies. The main sources of BC are combustion engines (especially diesel), residential burning of wood and coal, power stations using heavy oil or coal, field burning of agricultural wastes, as well as forest and vegetation fires. Consequently, BC is a universal indicator of a variable mixture of particulate material from a large variety of combustion sources and, when measured in the atmosphere, it is always associated with other substances from combustion sources, such as organic compounds. The spatial variation of BC is greater than that of PM_{2.5}. Although, in general, ambient measurements or model estimates of BC reflect personal exposures reasonably well and with similar precision as for PM_{2.5}, the differences in exposure assessment errors may vary between studies and possibly affect estimates of risk.

The systematic review of the available time-series studies, as well as information from panel studies, provides sufficient evidence of an association of short-term (daily) variations in BC concentrations with short-term changes in health (all-cause and cardiovascular mortality, and cardiopulmonary hospital admissions). Cohort studies provide sufficient evidence of associations of all-cause and cardiopulmonary mortality with long-term average BC exposure.

Health outcomes associated with exposure to PM_{2.5} or thoracic particles (PM₁₀) are usually also associated with BC (and vice versa) in the epidemiological studies reviewed. Effects estimates (from both short- and long-term studies) are much higher for BC compared to PM₁₀ and PM_{2.5} when the particulate measures are expressed per unit of mass concentration ($\mu\text{g}/\text{m}^3$). Effect estimates are, however, generally similar per inter-quartile range in pollutant levels. Studies of short-term health effects show that the associations with BC are more robust than those with

预览已结束，完整报告链接和二维码如下：

https://www.yunbaogao.cn/report/index/report?reportId=5_9343

