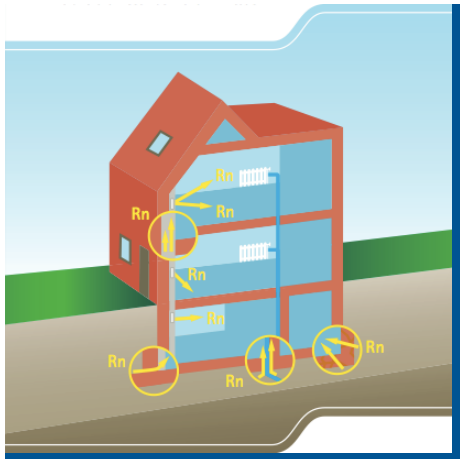


STAATSMINISTERIUM FÜR UMWELT UND LANDWIRTSCHAFT

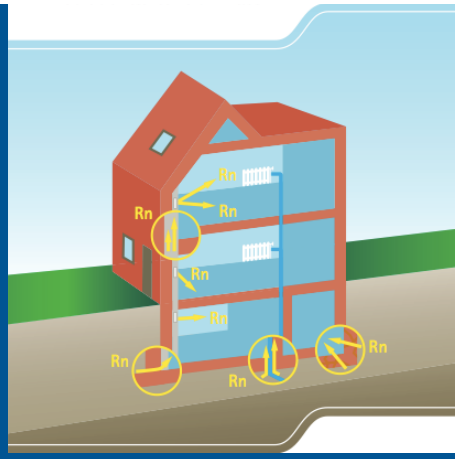
Freistaat SACHSEN

Radon protection conference

New challenges for the European construction and ventilation branches of Europe

Dresden (Sachsen, Germany)

December 2nd–3rd 2013



The approach of the Italian National Radon Action Plan for prevention in new buildings and mitigation in existing buildings and consideration on the forthcoming new European Directive on Basic Safety Standards

Francesco Bochicchio

(Italian National Institute of Health)

on behalf of the Working Group of the Italian National Radon Action Plan on Preventive Measures and Remedial Actions against Indoor Radon

Introduction

- The Italian National Radon Action Plan (INRAP) was prepared in 2002 by an working group of several experts (physicists, medical doctors, architects) and approved by the Ministry of Health.

- Its implementation started on 2005 and later on it evolved taking into account results of epidemiological studies and recent international recommendations and regulations

Important results from epidemiological studies

Pooled analysis of residential epi studies

	Cases	Controls	RR (95% CI) 100 Bq/m^3
2 Chinese studies (2004)	1028	1974	1.13 (**1.01**–1.36)
only complete (25y) Rn meas.	464		1.32 (**1.09**–1.88)
13 European studies (2004-5)	7148	14208	1.08 (**1.03**–1.16)
corrected for Rn exp. uncertainty	7148	14208	1.16 (**1.05**–1.31)
7 North-American studies (2005)	4081	5281	1.11 (1.00–1.28)
only complete (25y) Rn meas.	1621	2323	1.21 (**1.03**–1.50)

Important results from epidemiological studies

Pooled analysis of European epi studies

bmj.com

Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies

S Darby, D Hill, A Auvinen, J M Barros-Dios, H Baysson, F Bochicchio, H Deo, R Falk, F Forastiere, M Hakama, I Heid, L Kreienbrock, M Kreuzer, F Lagarde, I Mäkeläinen, C Muirhead, W Oberaigner, G Pershagen, A Ruano-Ravina, E Ruosteenoja, A Schaffrath Rosario, M Tirmarche, L Tomásek, E Whitley, H-E Wichmann and R Doll

BMJ 2005;330;223-; originally published online 21 Dec 2004; doi:10.1136/bmj.38308.477650.63

Scand J Work Environ Health 2006;32 suppl 1:1–84

Residential radon and lung cancer—detailed results of a collaborative analysis of individual data on 7148 persons with lung cancer and 14 208 persons without lung cancer from 13 epidemiologic studies in Europe

by Sarah Darby,[1] David Hill,[1] Harz Deo,[2] Anssi Auvinen,[3] Juan Miguel Barros-Dios,[4] Hélène Baysson,[5] Francesco Bochicchio,[6] Rolf Falk,[7] Sara Farchi,[8] Adolfo Figueiras,[4] Matti Hakama,[9] Iris Heid,[10] Nezahat Hunter,[11] Lothar Kreienbrock,[12] Michaela Kreuzer,[13] Frédéric Lagarde,[14] Ilona Mäkeläinen,[15] Colin Muirhead,[11] Wilhelm Oberaigner,[16] Göran Pershagen,[14] Eeva Ruosteenoja,[15] Angelika Schaffrath Rosario,[10] Margot Tirmarche,[5] Ladislav Tomášek,[17] Elise Whitley,[18] Heinz-Erich Wichmann,[10] Richard Doll[1]

Important results from epidemiological studies

Results of European pooled analysis

- Results are homogenous across studies
- Strong synergism between radon and cigarette smoking

  => smokers have similar *relative risk* but much greater *absolute risk*

- The increase of the lung cancer risk is statistically significant also selecting subjects exposed up to 200 Bq/m^3

  RR 100–200 Bq/m^3 vs <100 Bq/m^3 = 1.2 (1.03–1.30)

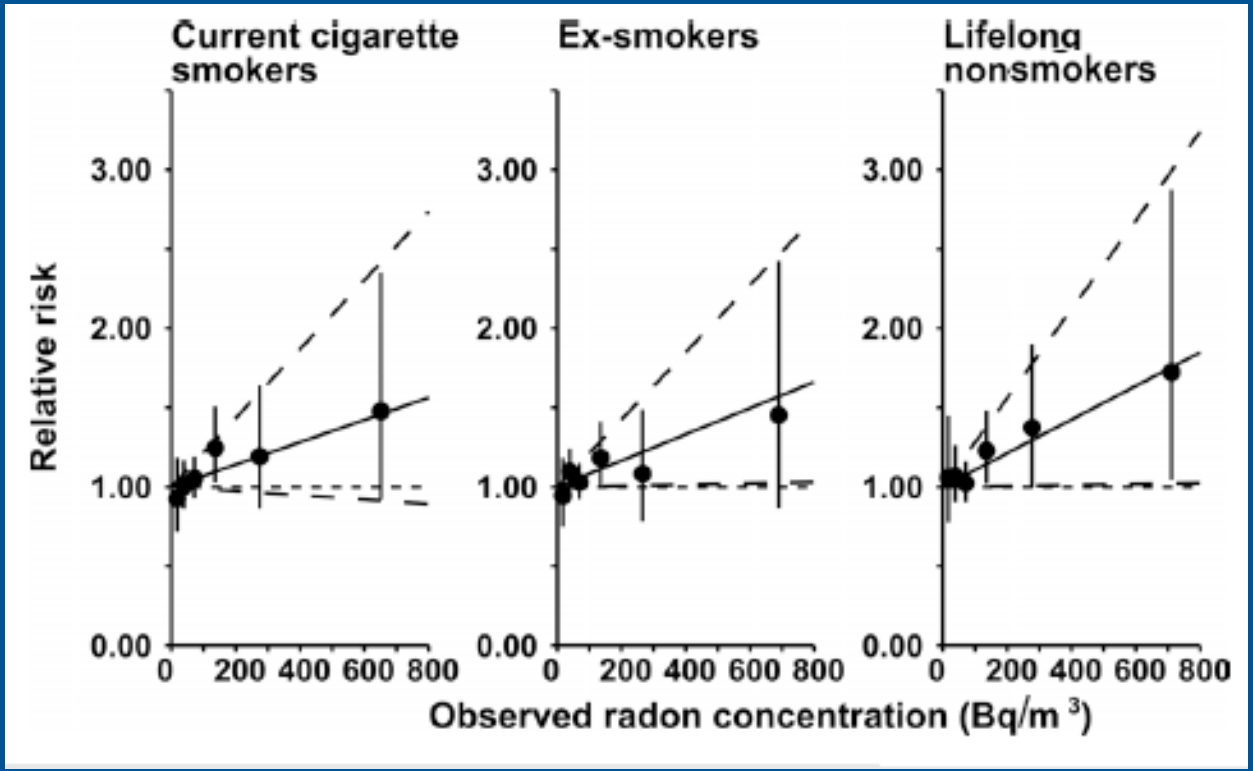
- Non linear models and models with threshold do not improve the fit goodness, compared with linear model with no threshold

  150 Bq/m^3 upper bound (95% CL) for a threshold

Important results from epidemiological studies

Interaction of Rn and cigarette smoking

- Most residential case-controls studies show very similar relative risk for current smokers, ex-smokers and never-smokers (i.e. ~multiplicative interaction between radon and smoking)



(from Darby et al, 2006)

Important results from epidemiological studies

Recent epi studies on miners

Recent epidemiological studies on miners are characterized by low radon exposures and concentrations

RADIATION RESEARCH 169, 125–137 (2008)
0033-7587/08 $15.00

Lung Cancer in French and Czech Uranium Miners: Radon-Associated Risk at Low Exposure Rates and Modifying Effects of Time since Exposure and Age at Exposure

Ladislav Tomasek,[a,1] Agnès Rogel,[b] Margot Tirmarche,[b] Nicolas Mitton[b] and Dominique Laurier[b]

[a] *National Radiation Protection Institute, Prague, Czech Republic; and* [b] *Institute for Radiological Protection and Nuclear Safety (IRSN), Fontenay-aux-Roses, France*

Important results from epidemiological studies

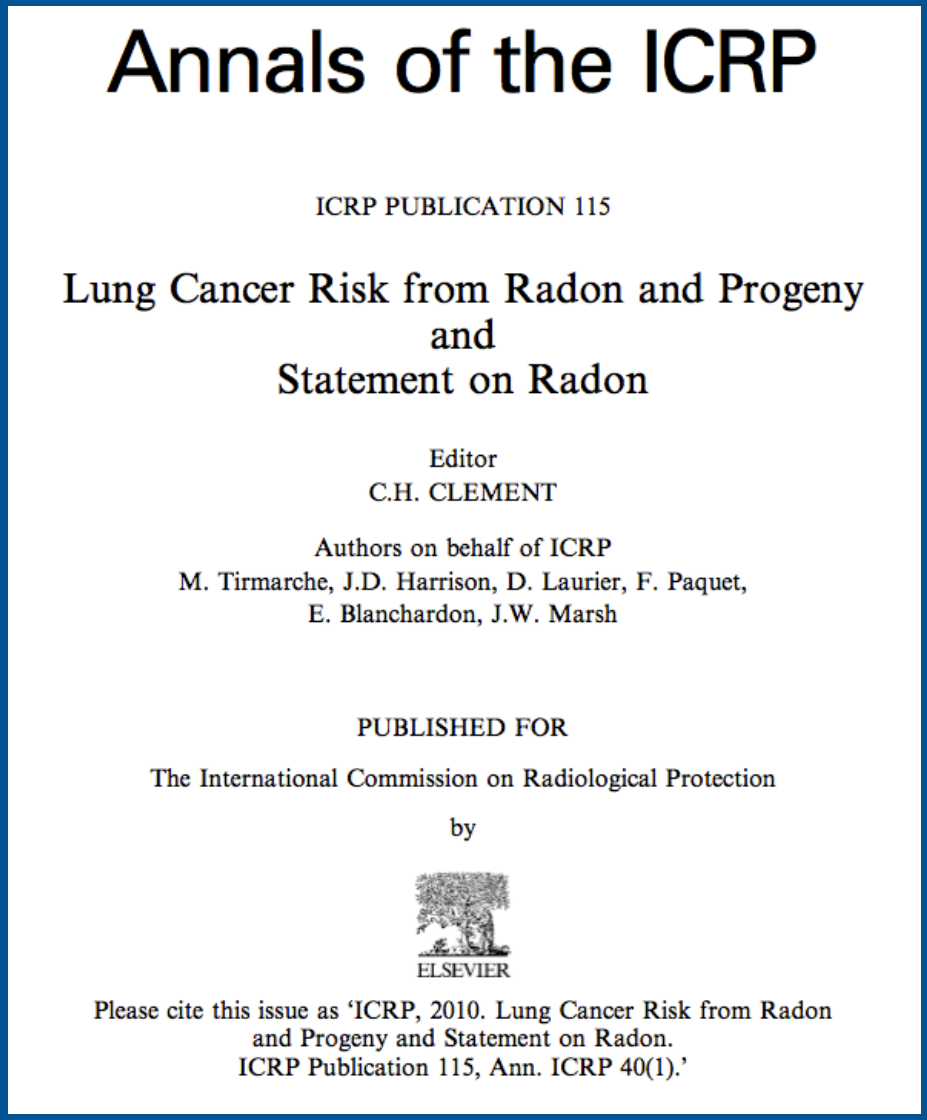
Recent results of miner epi studies

- **Methods**
  - Cohort studies, ~ 10,000 miners, 574 lung cancers (87% excess)
  - Low exposures and low exposure rates (i.e. low concentrations)
  - Good evaluation of the exposure
- **Results**
  - **Lifetime risk ~ 2 times higher than ICRP-65 (1993)**
  - Risk decreases with time since exposure and age
  - No inverse dose rate effect for concentrations < 4 WL

New risk/dose evaluation from ICRP

ICRP-115 (2010):
30 Bq/m^3 => 1 mSv/y

ICRP-65 (1993):
60 Bq/m^3 => 1 mSv/y



Annals of the ICRP

ICRP PUBLICATION 115

Lung Cancer Risk from Radon and Progeny
and
Statement on Radon

Editor
C.H. CLEMENT

Authors on behalf of ICRP
M. Tirmarche, J.D. Harrison, D. Laurier, F. Paquet,
E. Blanchardon, J.W. Marsh

PUBLISHED FOR

The International Commission on Radiological Protection

by

ELSEVIER

Please cite this issue as 'ICRP, 2010. Lung Cancer Risk from Radon and Progeny and Statement on Radon. ICRP Publication 115, Ann. ICRP 40(1).'

Important results from epidemiological studies

Implications on regulations and NRP

- Due to the log-normal shape of radon distribution, most of lung cancers attributed to radon are related to exposure levels up to ~200 Bq/m^3, i.e. below most Action/Reference Levels (ALs/RLs), but where the increase of the risk is still statistically significant
  - **action/reference levels should be reduced in order to significantly reduce the number of lung cancers**
  - **NRPs (National Radon Plans) should include plan for some actions in a much higher number of dwellings than with present ALs/RLs**

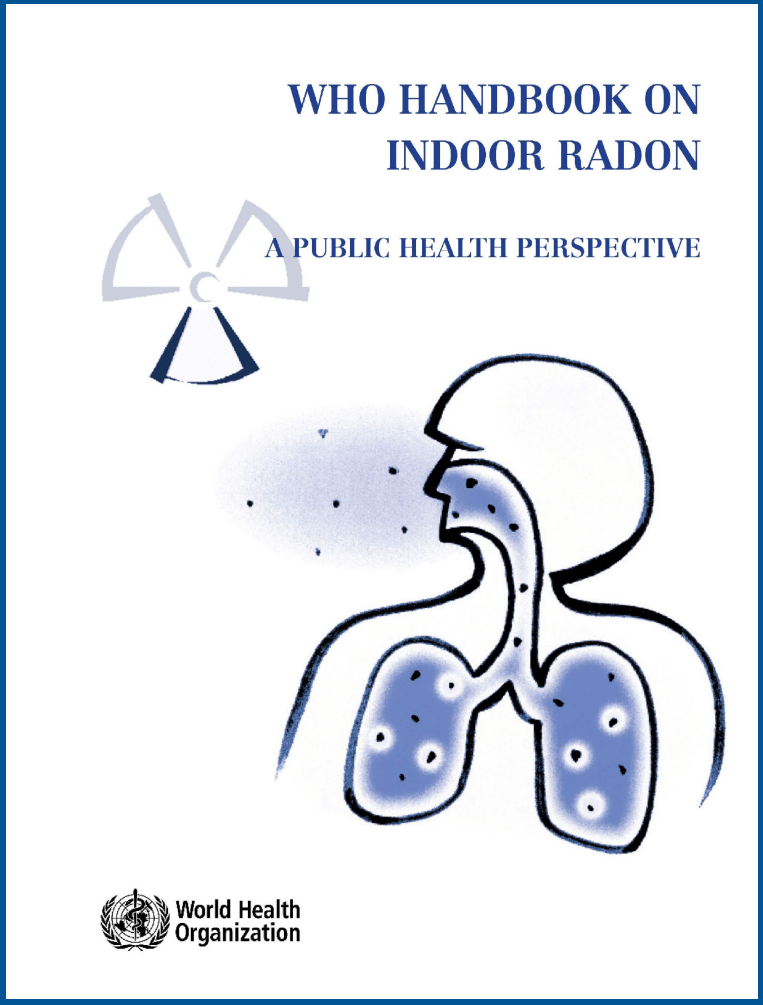
Important results from epidemiological studies

Implications on regulations and NRP (2)

- For the same radon exposure level, individual excess absolute risk (EAR) for smokers is ~25 times the individual excess absolute risk for never smokers
  - e.g. age 75 y, 200 Bq/m^3: EAR = 1.3 x 10^{-3} (NS)
    EAR =32 x 10^{-3} (S)
  - Although most of the population is non-smoker, most of lung cancers attributed to radon are actually due to the synergism between radon and cigarette smoking
  - Therefore, NRPs should be connected with programs on cigarette smoking reduction
  - Moreover, specific actions addressed to smokers would be very effective to reduce lung cancer risk from radon

Recent and forthcoming recommendations and regulations

WHO Handbook on Indoor Radon (2009)



A Public Health Perspective

Structure

Introduction

1. Health Effects of Radon
2. Radon Measurements
3. Prevention and Mitigation
4. Cost-Effectiveness
5. Radon Risk Communication
6. National Radon Programmes

5 key messages for each chapter

European project "RADPAR"

- The RADPAR (Radon Prevention and Remediation) was an European project funded by the Executive Agency for Health and Consumers (EAHC) of the EU Directorate General SANCO, and carried out in 2009–2012, in the framework of the Health Programme 2008–2013.
- 11 associated partner institutions from 10 European countries (Greece, Germany, UK, France, Italy, Austria, Norway, Finland, Belgium, Czech Rep.)
- 7 collaborating partners from 6 countries (Switzerland, UK, Finland, Spain, Portugal Ireland) and 1 Int. Organization (WHO)

RADPAR logo

RADPAR Recommendations

- A number of documents were produced within RADPAR, some of which can be downloaded from

  http://web.jrc.ec.europa.eu/radpar/documents.cfm

- A major document is a booklet of detailed (and quite comprehensive) recommendations:

  The RADPAR Recommendations

UNIVERSITY OF WESTERN MACEDONIA
DEP. OF MECHANICAL ENGINEERING,
GR 50100, KOZANI, GREECE

Rn

Radon Prevention and Remediation

The RADPAR Recommendations

John Bartzis, Hannu Arvela, Francesco Bochicchio, Jane Bradley, Bernard Collignan, David Fenton, Ivana Fojtikova, Alastair Gray, Bernd Grosche, Martha Gruson, Olli Holmgren, Jiri Hulka, Martin Jiranek, Krystallia Kalimeri, Stylianos Kephalopoulos, Michaela Kreuzer, James Mc Laughlin, Wolfgang Ringer, Katerina Rovenska, Dieter Schlesinger, Gennaro Venoso, Hajo Zeeb

European Commission

This publication arises from the project Radon Prevention and Remediation (RADPAR) which has received funding from the European Commission DG SANCO Second Public Health Programme.

The RADPAR recommendations: seven sections

1. **Recommendations on radon policy and strategy**
2. Recommendations on protocols for indoor radon concentration measurements
3. Recommendations to improve radon risk communication
4. Assessment of potential conflicts between energy conservation in buildings and radon exposure reduction
5. Establishment of measurement protocols for radon control technologies
6. Design of training courses for radon measurement, prevention, remediation
7. Recommendations on analysis of cost effectiveness and health benefits of radon control strategies

The INRAP approach for preventive measures in new buildings (1)

- Preventive measures are recommended in ALL the new buildings (and for renovations involving the lowest floor)
  - standard (=> less expensive) methods
  - problems of area or site classification are avoided
- Scope: reduce the ingress of radon from soil and provision for post-construction systems to facilitate a further reduction of radon concentration, if necessary
  - The final goal is to reduce both the global burden and individual (high) risks

The INRAP approach for preventive measures in new buildings (2)

- **Main components of preventive measures**
  1. a membrane to reduce passively radon ingress
  2. a passive ventilation system installed in the crawl space (if it is present) or in the sub-soil
     - a fan can be applied, if necessary, after construction
- In any case, simple modifications of usual construction methods are recommended
  - to avoid the need of significant specific training on radon
  - to be applicable to a high number of buildings

The INRAP approach for mitigation in existing buildings (1)

- Present regulation in Italy deal with workplaces only, with action level = 500 Bq/m^3

  => a relatively low number of buildings is expected to require mitigation/remediation

- Transposition of the forthcoming EU directive, with reference level ≤ 300 Bq/m^3 in both workplaces and dwellings

  => a much higher number of buildings is expected to require mitigation

The INRAP approach for mitigation in existing buildings (2)

=> a network of local building professionals trained and qualified in radon mitigation is needed

- However, this could be difficult

=> "normal" building professionals (i.e. with no specific training or qualification in radon mitigation) could also be involved for radon remedial actions, provided that they receive clear and operative instructions from professionals qualified in radon mitigation or can find such instructions in technical guides.

Some considerations regarding the forthcoming European Directive (1)

- Directive sets the minimum protection level and it is flexible. More protective levels/tools are permitted.
- In transposing EU directive and setting up National Action Plans we should try to learn from (and adapt) the previous experience of other countries
- We need to develop (and use) guidelines (e.g. WHO, IAEA, RADPAR, ecc.)
- In many EU Countries a recommendatory approach appears not to be very effective: a compulsory approach could be more effective and could be easily applied in several situations (e.g. building codes, public buildings, rent houses)

Some considerations regarding the forthcoming European Directive (2)

- European radon regulations are set-up in the Euratom framework, however:
  - we should link radon programs and regulations with other programs/regulations related with radon exposure and radon health effects (cigarette smoking, energy saving, building constructions/maintainance, indoor air)
  - Links and coordination are recommended by WHO, IAEA, EC, but they need large efforts due to administrative separation of related agencies/department

Some considerations regarding the forthcoming European Directive (3)

- Lower reference levels required by the EU Directive

  => we need research for mitigation systems capable to reduce "intermediate" radon concentrations (i.e. 100–400 Bq/m^3)

  in such cases we do not need high reduction efficiency

Danke Ihnen für Ihre Aufmerksamkeit

Thank you for your kind attention