A pan-European housing and health survey: description and evaluation of methods and approaches

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Abstract: Health threats exist in all residential environments. To gain information on potential health threats and hazards in and around the home environment, the Housing and Health programme of the WHO Regional Office for Europe, conducted a pan-European survey during 2002–2003. It is intended to use the results of the analysis of the data collected for proposing to governments of the European Member States priorities and evidence on which they could base their housing strategy and policy orientations. This paper describes and evaluates the chosen methodologies for study preparation and development.

Keywords: survey methodology; housing and health; European survey.


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Maggie Davidson is a Principal Consultant in the Housing Centre of the Building Research Establishment in the UK. She has a Degree in Psychology and has spent the past 25 years working in housing research. She is currently responsible for designing and analysing surveys related to housing issues and for most of the analysis and policy modelling using the government’s English House Condition Survey.

Nathalie Röbbel is a Sociologist and has a PhD from the Friedrich Wilhelms Universität in Bonn and is specialised in family sociology. She currently works as a Technical Officer on Environment and Health Partnerships in the WHO Regional Office for Europe. Her tasks in the framework of the housing and health project were the prevention of domestic accidents, the relationship between the residential setting and physical activity/obesity, and regulations on housing and health.

1 Study approach and purpose

1.1 Background

During the last decade, interest in assessing the health consequences of housing conditions and the general health relevance of places and spatial settings has increased and a variety of studies and research projects on housing and health issues have been undertaken. The evidence base for the complex effects of housing conditions on health is growing (Dannenberg et al., 2003; Evans, 2003; Fuller-Thomson et al., 2000; Shaw, 2004). However, no common definition of ‘healthy housing’ exists; in addition, major gaps still exist in the knowledge of how housing conditions affect health and which mitigation strategies are most successful. The pan-European study undertaken by the WHO Regional Office for the Europe housing and health programme looked at the perceptions of housing and health and explored the relations and associations between the quality of the housing stock with the self-rated health status and the prevalence of diseases and health problems. In general terms, the LARES (Large Analysis and Review of European housing and health Status) study data provided a strong association between the assessment of housing quality, and the health of the residents (Figure 1). The identified association also turned up within various socioeconomic subgroups, showing that bad housing affects health for rich as well as poor residents.
The WHO LARES study was conducted in 2002/2003 in eight cities: Forlì, Italy; Vilnius, Lithuania; Ferreira do Alentejo, Portugal; Bonn, Germany; Geneva, Switzerland; Angers, France; Bratislava, Slovakia; and Budapest, Hungary (Figure 2). Data were obtained from 8519 residents in 3373 households.

The main objectives of the study were to

- oversee and assess the quality of housing stock, which may affect residents’ health in a holistic way
- identify avenues that would allow priority setting and the development of housing and health policy at local level
- design a tool that enables local authorities to assess the prevailing housing and health conditions within their cities or regions
- develop guidelines and recommendations for policymaking.
1.2 Specifics of the survey tool

Central to the study design was WHO’s definition of housing as a broad concept, with four interrelated dimensions: the physical structure of the house as a shelter, the mental construct of the home as a safe harbour and refuge, as well as the place where family life occurs, the quality and infrastructure of the neighbourhood and the immediate environment, and the community and its residents, which form a social climate (Bonnefoy et al., 2003a).

The WHO study used three survey forms to reflect the holistic understanding of housing.

- A face to face interview conducted by a trained surveyor with one of the dwelling’s residents. The interview covered the resident’s perception of and satisfaction with a variety of health relevant characteristics of his or her home, including community information and the immediate environment.
- A visual inspection of the building and its immediate environment by a trained surveyor. The inspection collected data about the dwelling’s quality, physical condition, and technical equipment. No physical measurements were recorded.
- A self completed health questionnaire for all inhabitants. The questionnaire collected data on the health status of the occupants.

Previous housing surveys (ODPM, 2003) have shown that occupants do not always have a realistic and objective view of the condition of their home. Nearly 80% of occupants whose homes were assessed by professional surveyors against the need for major repairs, declare that their home is in a good or fair state of repair. Older people and those who own their own homes are more likely to have an unrealistically rosy picture of the state of their home compared with younger people or those who rent their homes. Overall, 35% of households whose homes are in substantial disrepair regard their homes as being in a very good or excellent state of repair. When the household reference person is aged 65 or over, this rises to 46%. Only one in eight households where the household reference person is aged 65 or over living in homes in poor repair agree that the state of repair of their home is poor or very poor (ODPM, 2003). Inspection by a trained independent surveyor is therefore essential to obtain the most objective measure of dwelling conditions. The information collected by the surveyor can then be related to the personal satisfaction of the residents and their assessment of the housing quality and can help to improve the analysis of the relation between housing conditions and health outcomes.

The three survey forms were based on the experience gained during a pilot survey conducted in 2000/2001 in two cities in eastern Europe (Vilnius, Lithuania, and Bratislava, Slovakia) and one city in eastern Germany (Schwedt and Oder) that focused on panel block buildings (Bonnefoy et al., 2003b; Braubach and Bonnefoy, 2001). The form design also drew on the extensive literature review and the advice of a multidisciplinary network of urban planners, epidemiologists, architects, sociologists, and public health specialists from WHO and from other institutions with relevant expertise (WHO Regional Office for Europe 2000, 2001). The forms integrated topics, elements, and questions from existing validated questionnaires such as the English House Condition Survey (ODPM); the Scottish Health, Housing and Regeneration Research Project (http://www.msoc-mrc.gla.ac.uk/SHARP/sharp.html); the Eurobarometer; the depression screening tool SALSA (Brody et al., 1998); and EQ5D
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(The EuroQol Group, 1990; Brooks, 1996). This approach enabled not only the use of validated question sets, but also a better comparison and benchmarking of the results with other relevant studies.

The questionnaires were translated into all relevant languages by WHO or by national partners, thus providing the highest possible level of consistency. The translations were tested in each country in five to six households with different age and education groups.

The complete survey tool was piloted in 20 dwellings each in Forlì, Bonn, and Vilnius. Pilot testing was performed by staff from WHO and from national health institutions and was undertaken in various housing types including small and large as well as old and young households. Pilot testing was a useful step in identifying shortcomings in the questionnaires, helping to amend questions that were difficult to understand, and ensuring the highest possible level of consistency.

The survey tool covered a variety of health relevant housing aspects (Table 1). The original tools can be viewed at http://www.euro.who.int/Housing/Activities/20041021_4.

Table 1  Housing and health aspects covered in the survey tool

<table>
<thead>
<tr>
<th>Housing aspects (Housing questionnaire and inspection sheet)</th>
<th>Health aspects (Health questionnaire)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household size and composition</td>
<td>Personal characteristics</td>
</tr>
<tr>
<td>Temperature, heating, and insulation</td>
<td>Selfrated health status</td>
</tr>
<tr>
<td>Air quality, air pollution, and ventilation</td>
<td>Functional or physical limitations</td>
</tr>
<tr>
<td>Damp, humidity, and mould</td>
<td>Problems to use dwelling</td>
</tr>
<tr>
<td>Natural light and artificial lighting</td>
<td>Mental condition/quality of life</td>
</tr>
<tr>
<td>Sanitary and hygiene installations</td>
<td>Depression screening tool</td>
</tr>
<tr>
<td>Safety and risk for accidents</td>
<td>Lifestyle or health behaviour (alcohol consumption, smoking behaviour, physical activity)</td>
</tr>
<tr>
<td>Pests, insects, and infestations</td>
<td>*Dwelling satisfaction was asked in the Housing questionnaire (answered by one representative of the household) and in the Health questionnaire (answered by each resident) to identify the degree of variation of dwelling satisfaction within the members of the same household.</td>
</tr>
<tr>
<td>Environmental tobacco smoke</td>
<td>Sleep disturbance/noise annoyance</td>
</tr>
<tr>
<td></td>
<td>Dwelling satisfaction*</td>
</tr>
<tr>
<td></td>
<td>Psychosocial benefits of the home</td>
</tr>
<tr>
<td></td>
<td>Accidents/injuries</td>
</tr>
<tr>
<td></td>
<td>Chronic and acute illnesses and symptoms (reported and diagnosed)</td>
</tr>
<tr>
<td></td>
<td>Use of medicines</td>
</tr>
</tbody>
</table>

The questionnaires contained 290 questions with 1,095 items. Eleven percent of the questions allowed for open answers, 76% were closed questions and the remaining 13% were closed questions, using a Likert scale format (Geyer and Siegrist, 1998). The final scales used in the survey tools can be categorised into three types.
Five point ranking scales using smiley faces (so called Kunin scale) were used to assess subjective satisfaction. With this scale, the interviewee was neither given a value (e.g., 1–5), nor a verbal expression (e.g., bad or good) that could be subject to different interpretation depending on cultural background.

Five point Likert scales with clear polarity, giving a verbal assessment only for option 1 (e.g., highly dissatisfied) and 5 (e.g., highly satisfied) define the ends of the scale, but do not limit the individual’s assessment of the intermediate ranking options.

Five point Likert scales with continuous ranking values for frequency (e.g., never, seldom, sometimes, often, permanent) were used.

1.3 The survey design: multicity cross sectional survey

For many of the possible relations between the housing characteristics and health status, functional and targeted hypotheses were either not available or seemed limited; therefore, an exploratory design was chosen as the best option. This method enables broad data analysis for identifying many potential associations between housing and health parameters. This design was chosen with the knowledge that it severely limits the capacity to use the results in a more causal way (Bonaiuto et al., 1999; Diez Roux, 2001, 2002; Flade, 1998).

The international scale of the project and the diversity of existing regulations led to the cross sectional study design. Diseases – and, to a large extent, exposure status – were measured simultaneously. This method was chosen to provide a ‘snapshot’ of the frequency and characteristics of a disease in a population at a particular point in time. This type of design can be used to assess the prevalence of acute or chronic conditions in a population.

The survey focused on collecting subjective data and residents’ perceptions. Data were collected through face to face interviews in the private homes of the sampled households (Amerigo and Aragones, 1997; Anderson and Weidemann, 1997). These data were integrated with the dwelling inspection, which collected more objective data.

Finally, physical measurements such as temperature, noise, and humidity with data loggers were not recorded. The main reasons for not recording these measurements were equipment and staff costs as well as the logistical challenge of measurements taken in private households in several countries. In many instances, measurements would have needed to be recorded over a minimum of one week to provide useful and reliable data.

Many challenges were met to devise a common survey instrument for use in the eight countries. Challenges included

- differences in dwelling stock types, materials used, amenities present, and housing conditions
- differences in ownership arrangements
- differences in climate
- different cultural norms and perceptions
- language and translation issues
- practical and legal issues with regard to confidentiality and the use of public records for sampling.
2 Methods

2.1 City selection

One of the survey priorities was to guarantee the coverage of northern, southern, eastern, and western Europe. To meet this need, a convenience sample of participating cities was drawn. City selection was based on existing networks, resources and the city’s interest in the project. The cities were not intended to be representative either of any country’s or of the enlarged European Union’s population. Although they do cover a range of geographic locations, the cities essentially represent themselves and provide a combined data set that allows analysis of relationships among dwelling characteristics, residents’ perceptions, and health outcomes. Table 2 gives some information on the size of the cities and the amount of one person households, and on the population and gross national product of the respective countries.

2.2 Sampling methods

When possible, the city population register was used as the sampling frame because the aim was to produce a representative sample of residents in each city. These residents were the link to a full household. The survey addressed all residents within a selected dwelling, not only the chosen individual. The sampling frames used all residential addresses except secondary residential addresses (except in Budapest and Bratislava), nursing homes, military barracks, and dormitories.

Because of specific national privacy laws, alternative sources had to be used in two cities. In Angers, the database of built properties provided by the local tax registry was used as the sampling frame. In Ferreira do Alentejo, the sample was drawn from the health centre management system (SINUS) database, which includes all health service users in the city.

In all cases, the initial sample was drawn as a straight random sample of 800 to 1,700 addresses. The size of each sample depended on the size of the city, the expected response rate (based on experiences with local surveys and the WHO pilot test), and the number of interviews needed for representativeness. In general, a realistic average participation rate was estimated as the response rate of roughly 40–60% and a noncontact rate of 20%. This rate was then adjusted to the local conditions. The size of the selected samples therefore ranged from 600 (Ferreira do Alentejo) to 1,700 (Budapest), with a minimum of 350 to 500 expected interviews, respectively.

The initial samples for Angers, Bratislava and Budapest contained a number of duplicate entries that reduced the effective sample size. In addition, the original sample in Angers contained instances where the named person was the owner of the building but not the resident, which made contacting the actual residents more difficult.
Table 2

<table>
<thead>
<tr>
<th></th>
<th>Angers</th>
<th>Bonn</th>
<th>Bratislava</th>
<th>Budapest</th>
<th>Ferreira</th>
<th>Forli</th>
<th>Geneva</th>
<th>Vilnius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>156,000</td>
<td>312,317</td>
<td>446,819</td>
<td>1,719,342</td>
<td>9010</td>
<td>110,209</td>
<td>179,437</td>
<td>542,287</td>
</tr>
<tr>
<td>Population of the countries (2002)</td>
<td>59,486,121</td>
<td>82,488,495</td>
<td>5,379,056</td>
<td>10,158,608</td>
<td>10,368,403</td>
<td>57,321,070</td>
<td>7,289,542</td>
<td>3,469,070</td>
</tr>
<tr>
<td>GNP per capita in PPS$^\text{a}$ (2003)</td>
<td>(France)</td>
<td>(Germany)</td>
<td>(Slovakia)</td>
<td>(Hungary)</td>
<td>(Portugal)</td>
<td>(Italy)</td>
<td>(Switzerland)</td>
<td>(Lithuania)</td>
</tr>
<tr>
<td></td>
<td>111</td>
<td>108</td>
<td>52</td>
<td>61</td>
<td>74</td>
<td>107</td>
<td>131</td>
<td>46</td>
</tr>
<tr>
<td>One-person house-holds in the cities</td>
<td>32,949</td>
<td>88,708</td>
<td>69,405</td>
<td>212,257</td>
<td>656</td>
<td>13,032</td>
<td>(Not available)</td>
<td>73,993</td>
</tr>
</tbody>
</table>

$^\text{a}$Based on s data and local statistics provided by the municipalities of the surveyed cities.

$^\text{b}$PPS (purchasing power standard), EU25 = 100.
2.3 Survey implementation

A standard survey implementation followed the subsequent course of action:

- piloting and translation of the survey tools
- preparation of the sample
- surveyor identification
- sending letters to selected households
- surveyor training
- press conference
- allocation of addresses to the surveyors
- telephone/visit for first contact
- implementation of the interview and the inspection
- collection of health questionnaires
- data entry
- validation
- data cleaning
- preliminary analysis
- preliminary report
- meeting with local council and presentation of first results.

2.3.1 Local base setup

The practical arrangements for running the survey were similar in all eight cities. The headquarters was in a large room, or where not possible, in an office with several rooms. This allowed for the exchange of information and control over the work done. The rooms were provided by the local WHO counterparts and were equipped with tables, telephones, personal computers, and printing and copying facilities. In each city, 8–13 survey teams worked fulltime for 17–18 working days, with the exception of Geneva, where the survey was conducted between March and May. Teams were supported by additional staff to help collect the health questionnaires and to perform data entry of the completed forms. All staff members were recruited by the local municipalities or national counterparts. A WHO representative, assisted by a local representative, coordinated the local work.

2.3.2 Surveyor training

All survey teams and support staff attended a standardised three day training course to ensure that they had
• a good understanding of each individual survey tool to be used and of the whole system of survey tools
• the ability to explain the objective of the questionnaires and the purpose of the survey project
• the ability to explain the individual questions and precoded answers
• a similar evaluation and assessment standard to reduce interrater variability
• some general knowledge of how to conduct interviews and how to lead a conversation
• a good overview of his or her daily tasks and duties as a surveyor
• confidence in approaching the households by telephone or through personal visits to make appointments.

The surveyors were either students in their fourth or fifth year of university (from relevant backgrounds such as medicine, sociology, architecture, or geography) or young unemployed professionals. Training was conducted by a WHO representative (translated into the local language if needed) to ensure consistency.

Training consisted of lectures and practical exercises such as assessment tests, followed by feedback and discussion to reinforce the standards or simulate the interview. The training also clearly identified technical terms such as ‘heating system’, ‘forced ventilation’, or ‘inhabitable rooms’, to ensure that every surveyor in every country had a similar understanding of the concepts. Each surveyor was provided with a glossary of technical terms.

2.3.3 Contact with households

A number of key steps were taken to maximise response rates.

• One week before the beginning of the survey in each city, a press conference was held to explain the purpose and content of the survey, to stress the role of the local authority, and to give assurances of confidentiality.

• All households selected for the sample were sent a letter signed by both WHO and the mayor of the city. The letter provided more details about the survey and a contact number for further information. Introductory letters have proved to be a useful method for increasing participation rates among those receiving them (Smith et al., 1995).

• Where the household’s telephone number could be traced (for 50–70% of homes), contact was first made by telephone to secure cooperation and to agree on a date for the interview and visit.

The exact figure of households having their home phone number accessible from the phone book is not known for all the cities surveyed. It appeared that there was a significant number of households who did not hold fixed phones anymore and relied on a mobile, which number could not be traced. Households without a telephone were visited by the surveyors. If no one was at home, the surveyors left an information card with a telephone number to call for an appointment. This strategic choice is likely to have
resulted in overselection of households with a telephone. However, it can be assumed that using only ‘cold visiting’ methods would probably have resulted in lower response rates, especially given the short duration of the fieldwork period (2 to 3 weeks in each city).

To maintain an overview of survey progress, all survey teams were required to track their work and provide all necessary elements for survey coordination. This included data on the number of contacted households, number of completed interviews, number of scheduled interviews (when and where), number of nonparticipating households (with detailed information about reasons for not participating) and nonresponse households (as a result of incorrect addresses, wrong telephone numbers, etc.), and number and date of questionnaires to be picked up.

2.3.4 Data collection

Surveyors worked in pairs. The interview, which collected subjective data about the respondent’s perception of his or her home, immediate neighbourhood and community, was conducted by one surveyor with one member of the household (normally the head of household or his or her partner). The inspection was performed by the second trained surveyor, who recorded his or her observations about the housing conditions and the immediate environment. Using trained surveyors to conduct the dwelling inspection was essential to the consistency of data on the condition of the home.

The third part of the survey consisted of a health questionnaire completed by each inhabitant of the surveyed dwelling. Each inhabitant, including children, reported his or her health condition. For children below 12 years, the information was given by the parents. This age was a guideline: in some cases, younger children wanted to fill out the health questionnaire by themselves; in others, parents filled out the questionnaires of older children. The three components took approximately 60 minutes to complete.

To guarantee completeness of the information, surveyors returned to collect the self-completed health questionnaires rather than simply relying on the respondents to mail them.

To secure the cooperation and to maximise the response rates, surveyors were paid according to results rather than a flat rate per day. They had preset objectives with added incentives in case of particularly good performance or severe difficulties.

2.4 Quality control

Several steps were undertaken to check the quality of the data. Quality controls were implemented at five levels: randomly allocating the addresses of the selected households to the surveyors, checking the complete forms by hand, performing quality checks of the interviews, validating the entered data, and cleaning the databases.

Allocation of addresses

The training methods and use of objective questions helped to reduce the variability of assessments. However, if surveyors work in limited areas in each city, a concentration of particularly strict or particularly lax assessments could develop, making some areas look a lot better or a lot worse than they really are. To minimise this type of bias and further reduce interrater variability, addresses distributed throughout all neighbourhoods from the sample were randomly allocated to surveyor teams.
Checking completed forms by hand

All completed questionnaires were checked daily by the WHO representative as soon as possible after they were returned. Where information was missing or unclear, the interviewer was asked to resolve the query. This checking proved particularly useful in filling gaps in the information and reconciling inconsistencies. In addition, it enabled WHO to identify interviewers who continued to make the same mistakes and to provide those interviewers with the necessary help or feedback to improve their work.

Quality checks of interviews

A random selection of 8–10% of interviews was checked through callback or personal visit by the WHO representative. Checks involved confirming with the respective household that the surveyors had actually conducted the survey as well as confirming key data items collected in the survey.

Computer validation

When questionnaire data were entered into the database, 10% were randomly checked by the WHO representative to control the data entry quality.

Data cleaning

A significant amount of time and energy was spent after the end of each survey on detecting and correcting errors and inconsistencies in the database. A representative of each city was invited to stay for six weeks at the WHO European Centre for Environment and Health, Bonn to clean the database. Missing information was added by going back to the paper questionnaires. The goal of the data cleaning was to have a complete database and to eliminate inconsistencies not detected during the first quality checks (e.g., inconsistency between identical questions in the interview questionnaire and in the self-completed health questionnaire).

2.5 Data analysis

After implementation of the survey (2002/2003), WHO established a consortium of international research institutions in the area of housing and health. Experts from seven countries and 17 institutions covering all scientific fields related to housing and health analysed the LARES data and produced a first internal report. These first findings supported the housing and health proposals included in the June 2004 Budapest ministerial declaration with regard to potential ways forward for ministers of health and environment (http://www.euro.who.int/document/HOH/ebackdoc01.pdf). The main analysis topics of the consortium are noise and sleep disturbance; domestic accidents; hygrometric and thermal comfort and perception; socioeconomic status, heating, and energy use; psychosocial and health benefits of housing; mental health, depression and housing; housing, residential conditions, and obesity; residential quality of life; socioeconomic status, neighbourhood deprivation, and health; housing scores; allergies and health; the impact of the residential environment on health; exposure to environmental tobacco smoke; pests; dampness, mould, and housing; functional limitations, accessibility, and environmental design; and perceived safety and fear of crime (http://www.euro.who.int/Housing/Activities/20041021_2).
3 Results and interpretation

3.1 Response rates

Table 3 shows response information for each of the eight cities. ‘Adjusted response rate’ is the ratio of the number of successful interviews to the number of eligible households selected where some attempt was made to contact the household.

<table>
<thead>
<tr>
<th></th>
<th>Angers</th>
<th>Bonn</th>
<th>Bratislava</th>
<th>Budapest</th>
<th>Ferreira</th>
<th>Forlì</th>
<th>Vilnius</th>
<th>Geneva</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households selected</td>
<td>800</td>
<td>1100</td>
<td>1314</td>
<td>1768</td>
<td>600</td>
<td>800</td>
<td>1100</td>
<td>1200</td>
<td>8682</td>
</tr>
<tr>
<td>Ineligible(a)</td>
<td>37</td>
<td>84</td>
<td>170</td>
<td>101</td>
<td>68</td>
<td>6</td>
<td>13</td>
<td>162</td>
<td>641</td>
</tr>
<tr>
<td>Not used/other</td>
<td>–</td>
<td>113</td>
<td>111</td>
<td>–</td>
<td>70</td>
<td>–</td>
<td>5</td>
<td>–</td>
<td>299</td>
</tr>
<tr>
<td>exclusions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eligible households</td>
<td>763</td>
<td>903</td>
<td>1033</td>
<td>1667</td>
<td>462</td>
<td>794</td>
<td>1082</td>
<td>1038</td>
<td>7742</td>
</tr>
<tr>
<td>Noncontacts(b)</td>
<td>48</td>
<td>120</td>
<td>206</td>
<td>610</td>
<td>38</td>
<td>100</td>
<td>78</td>
<td>290</td>
<td>1490</td>
</tr>
<tr>
<td>Refusals</td>
<td>288</td>
<td>391</td>
<td>489</td>
<td>592</td>
<td>67</td>
<td>291</td>
<td>319</td>
<td>393</td>
<td>2830</td>
</tr>
<tr>
<td>Interviews done</td>
<td>427</td>
<td>392</td>
<td>338</td>
<td>465</td>
<td>357</td>
<td>403</td>
<td>685</td>
<td>355</td>
<td>3422</td>
</tr>
<tr>
<td>Full household</td>
<td>427</td>
<td>390</td>
<td>338</td>
<td>447</td>
<td>357</td>
<td>397</td>
<td>684</td>
<td>333</td>
<td>3373</td>
</tr>
<tr>
<td>interviews in the</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>database(c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of residents</td>
<td>880</td>
<td>946</td>
<td>892</td>
<td>1086</td>
<td>1055</td>
<td>1157</td>
<td>1793</td>
<td>710</td>
<td>8519</td>
</tr>
<tr>
<td>in the database(d)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Adjusted response</td>
<td>56</td>
<td>43.4</td>
<td>32.7</td>
<td>27.9</td>
<td>77.3</td>
<td>50.8</td>
<td>63.3</td>
<td>34.2</td>
<td>44.2</td>
</tr>
<tr>
<td>rate(d) (%)</td>
<td></td>
<td></td>
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</tbody>
</table>

\(a\)Addresses were removed from the original sample if the selected person had moved; was living in a home for the elderly, a student dormitory, or a hospital; was unknown in the house; or was dead. Addresses were also removed if they were office or secondary addresses or if they could not be found.

\(b\)Surveyors tried to contact the households but were not successful.

\(c\)Some of the interviews were not complete and were – therefore – not included in the final database.

\(d\)The adjusted response rate has been calculated on the base of the eligible households and the number of interviews done.

The response rate varied among the cities and was generally lower in bigger cities. A number of reasons exist for this variation between cities, including cultural differences, size of city, time of year, proportion of inhabitants with a telephone, quality of the sampling frame information, and quality of the survey teams. For example, response rates in Bratislava may have been lower than in the other cities because the fieldwork was conducted just before the Easter holiday and problems arose with duplicates in the
sample. In Budapest, the low response rate might be attributed to a combination of the survey period coinciding with holiday time and the large distances to travel across the city. The high response rate in Ferreira do Alentejo, on the other hand, could be explained by the city’s small size, which facilitated surveyors’ journeys and ensured good communication about the survey.

The response rates in some cities (Angers, Bonn, Ferreira do Alentejo, Forlì, and Vilnius) were around or above what would be expected of a survey of this type (e.g., ODPM, 2003; Bates et al., 2002; Simmons and Dodd, 2003). Response rates in Bratislava, Budapest, and Geneva were much lower than would be expected.

Noncontacts (average rate of 14.6%) were mainly due to a very short fieldwork period in each city (2–3 weeks) and to the lack of the availability of telephone numbers in some cities, which reduced the probability of getting in touch with the selected households. Except for Ferreira do Alentejo, refusal rates were also higher than those usually observed in most cities (ODPM, 2003; Bates et al., 2002). Some selected households may have been discouraged from participating because of the duration of the interview and inspection, the surveyors’ inspections of private rooms in the dwelling, and the fact that two surveyors were present in their dwelling at the same time.

The overall major reasons for nonparticipation were: no time (23%); no interest (18.5%); fear (10.2%); health reasons (8%); holiday (3.4%); and other/unknown (36.9%).

3.2 Representativeness of the sample

Systematic differences between those who cooperate and those who refuse or cannot be contacted during surveys are encountered in almost every survey. Where possible, the distribution of the characteristics of respondents for each city from the LARES survey was compared with the official data obtained from the cities. It should be noted that the official data were of uneven quality and sometimes used different categorisations and definitions. However, these data did allow some indications of the representativeness and assessment of the type and level of bias affecting the sample. The following analysis of the representativeness is based on a 95% confidence interval. Depending on the frame of reference, the analysis was undertaken either using the housing database or the population database. The housing database represents all households and contains all information about the dwelling, household structure, and health status of the resident responding to the interview questions. The population database represents all residents and includes the information on the dwelling, the household, and the health status all individuals living in the dwelling.

Population database: age, gender, and neighbourhood distribution

In most cities in the LARES population database, some bias relative to age seems to exist. The pattern of bias is not consistent between the cities. For example, in Vilnius, people aged under 20 are underrepresented, but this age group is overrepresented in Bonn, Budapest, and Geneva. In Angers, the only concern is a slight overrepresentation of those aged 80 and over. Bonn shows a slight overrepresentation of children aged 0–5 and 6–17 years, whereas adults aged 18–29 years and 65 years and over are underrepresented. Budapest and Geneva are characterised by an overrepresentation of the group aged 0–19 years and Ferreira do Alentejo by an overrepresentation of the group aged 40–59 and an underrepresentation of the population aged 60–79 years. For Vilnius, the statistical analysis showed that groups aged 0–19 and 20–39 years are
underrepresented while the groups aged 40–59 and 60–79 years are overrepresented. In Bratislava and Forlì, no significant difference exists in the age distribution from the city data and from the LARES sample.

No significant bias exists relative to gender in any of the cities.

Some significant differences exist between the proportions of inhabitants living in each quarter for Budapest, Forlì, Ferreira do Alentejo, and Vilnius in the LARES sample and in the city data. Bonn, Bratislava, and Geneva show no significant differences (see details at: http://www.euro.who.int/Housing/Activities/20041221_1).

**Housing database: household size and house type**

The average household size from the LARES city housing samples exceeds the average household size in the surveyed cities. This distribution is a natural consequence of the sampling methodology, which used population registers to draw the samples. Using the population register that included all children was the most reliable method for ensuring identical sampling procedures in all cities (with the exception of Angers and Ferreira do Alentejo, where the samples were drawn from another source) and for guaranteeing comparability of the data. At the same time, this method increased the probability of selecting larger households; for instance a four residents household was twice as likely to be selected as a household with two residents.

Comparison of the distribution of housing type in the LARES housing samples and the distribution of housing types provided in other city databases shows no major deviations, with the exception of Geneva, where multifamily houses are overrepresented, and Angers, where multifamily houses are underrepresented (http://www.euro.who.int/Housing/Activities/20041221_1).

### 3.3 Overall representativeness of the samples

The study results suggest that some biases exist and some adjustments need to be made for analysis of data from individual cities to ensure that estimates derived from these surveys of the numbers of people and households are reliable. Additional comparisons could be made, but the data from cities themselves were limited. Should experts wish to perform specific analysis at city level based on the existing database, to draw conclusions valid for the city itself, it would be then recommended that the cities review this issue and calculate correction factors. For the analysis of the combined data set that examines relations among personal characteristics, housing, and health problems, correction factors are not needed.

### 3.4 Scientific results

Due to the explorative approach, the LARES database provides the opportunity to describe the potential associations between housing conditions and health effects, and allows for an assessment of the relative magnitude of health relevance of the factors that are present in the housing environment. The results of the survey provide some new evidence on existing gaps of knowledge, as well as confirm some already known data on the impact of housing conditions on health (e.g., for areas such as mould, noise, or sanitary equipment). In all cities, there was a clear socioeconomic gradient for both housing conditions and health. The necessity of activities and interventions in the housing and health area could therefore be confirmed for each city. Detailed results nevertheless
showed that each city has its own ‘housing and health profile’, so that the general trend (housing affects health) is based on the local strengths and weaknesses in each city. Still, some generally valid problem areas were identified for all cities, such as noise exposure, problems with thermal comfort for the poorer population parts, and the issue of accessibility of the housing stock for the elderly and residents with functional limitations.

New pieces of knowledge could be identified e.g., for the areas of

- home safety and the influence of noise and sleep disturbance on accidents
- residential environment quality and physical activity/obesity
- the significance of housing conditions for social and mental wellbeing.

However, the presentation of the scientific results is not the purpose of this paper and will be done by various publications of the LARES research group (see for example Niemann et al., 2005; Braubach, 2007 or Ellaway et al., 2005).

4 Study strengths and weaknesses

4.1 Cross-sectional design

Because the study was designed as a cross sectional survey, the database has limitations in identifying the causality of the relations between residential environment conditions and quality of life measures such as health and wellbeing. In addition, the study does not address the precise etiology of observed health effects. Nevertheless, the results gained will be helpful for identifying associations and correlations between residential environment and health or wellbeing and will indicate where causality may potentially exist (Rushton and Elliott, 2003), and help generate hypotheses that need further testing.

4.2 Subjective assessment of housing conditions

The use of residents’ subjective evaluations of the housing conditions provides opportunities that surveys based on measurements cannot provide. Health related to housing is a complex construct based on both the objective physical conditions and on the interaction between the dwelling and the resident. Subjective values and perceptions account for a considerable portion of the personal housing condition evaluation, especially the assessment of the subjective impact of residential environments on the residents’ health and wellbeing.

4.3 Internationality

This study covered a range of geographic locations throughout Europe, enabling the analysis of the relations between housing and health under various national conditions. Housing stock variations, climate, and cultural differences were taken into account when designing the questionnaires. Accounting for these differences helped to ensure the creation of a comprehensive database. This crossnational database is a useful tool for identifying the avenues that allow priorities to be set among the range of problem areas of housing and health in Europe and for identifying variations among European countries, in housing parameters that influence health outcomes. The existing methodology is
obviously transferable to other countries outside the European Region that know similar housing conditions. It is estimated that minor modifications of the survey tool would be needed to allow independent research teams to undertake a similar exercise in order to identify local housing conditions that affect the health of the population.

4.4 Translation

The questionnaires were translated to all relevant languages either by WHO or by national partners, thus providing the highest possible level of consistency. A back translation was not undertaken. To mitigate translation bias, detailed definitions of all relevant technical and assessment terms were formulated and were discussed and explained during surveyor training. In addition, each set of questionnaires was tested in each country in five or six households with different age and education groups. Nevertheless, a back translation would have been an additional step to maximise the consistency of the survey tool.

4.5 Scaling of answer options

In the survey questions, five point Likert scales were used as often as possible for ranking and assessing questions. Such a scale seemed the most acceptable choice for all countries and cultures because it clearly shows the polarity of answer options from one extreme to the other and it leaves a middle option.

4.6 Validity of survey tool

Because the objective assessment of dwelling conditions was based on the evaluation of the surveyor, special attention was paid to the consistency of assessments. For this reason, many efforts were made to standardise surveyor training. Nevertheless, collection and evaluation of the results of the practical exercises during the training and test-retest agreements could provide additional useful information for analysis of reliability. For the health questionnaire, validated elements from existing survey tools, such as the English House Condition Survey, the Scottish Health, Housing and Regeneration Research Project, the Eurobarometer, the depression screening tool SALSA and EQ5D were used.

4.7 Data quality

The examination of data quality revealed the following:

- In all cities, the samples were selected randomly, following the same approach. The most recent sampling frame available was used in all cases.

- The average low response rate in some cities is, in some cases, compensated by the strenuous efforts made to ensure consistency and reliability of the data and which ensured a high quality. However, the cities need to conduct further work to assess and correct for any bias.
The quality of the data was mainly assured by consistent training in all cities, detailed and consistent definitions of the technical terms in all languages, use of five point Likert ranking scales, and random allocation of addresses within the city to avoid biased estimate of the housing circumstances of particular neighbourhoods and housing types. Data quality was also assured by quality control measures (form checking, callbacks, computer validation, automatic filtering of some wrong answers by the data entry software, and data cleaning), and the collection of the health questionnaires by surveyors to guarantee the completeness of the set of questionnaires for each household.

4.8 Confidentiality

All data entered into the database are anonymous and cannot be traced to specific addresses or individuals. The people interviewed, however, were asked whether they would be willing to be contacted for further follow-up. If they agreed (32% of the household agreed), their full addresses and telephone numbers were recorded and stored in a secure WHO database.

4.9 Cost effectiveness of the survey

This extensive international survey was only possible because of the strenuous effort and commitment of the local municipalities and the WHO counterparts working at the national level. The cities supported the implementation both financially and logistically. The cities paid the surveyors’ salaries, provided free transport for survey teams, covered telephone costs, and delegated one staff member for the data cleaning. The cities also provided the offices, equipment, samples, and study promotion through the media.

5 Conclusions and recommendations

Initial analysis of the data undertaken by a consortium of research institutions established by WHO in the area of housing and health underlines the achievements of the study. These first findings supported the proposals, included in the Budapest ministerial declaration, for potential ways forward for ministers of health and ministers of environment (Bonnefoy et al., 2004).

From the methodological point of view, the sampling methods are sound and represent good practice. As with virtually all sample surveys, some problems of response bias exist, but these are not insurmountable.

When analysing the prevalence of particular housing conditions or health outcomes, it is recommended that the cities review the bias and calculate correction factors. When analysing data at the household level, cities will also need to calculate correction factors to remove the bias toward larger households. Corrections are only necessary at a local analysis level and not for analysis of relations in the data set combining all eight cities.

A number of improvements could be made to the surveys to improve the data quality and usefulness and to reduce bias in similar future surveys; however, most of these would increase the costs of conducting such surveys.
• Improve the selection procedures and training for interviewers, using trained building professionals for the dwelling inspections.

• Allow sufficient time for recalls; do not restrict the length of the fieldwork period artificially. Interviewers should be required to make five calls at an address before classifying it as a noncontact.

• Collect more information about noncontacts and refusals and match the information with other data sources to establish better estimates of the extent and nature of response bias.

• Introduce consistent recording of survey outcomes to distinguish clearly among addresses that are ineligible, noncontacts, and refusals.

• Perform a back translation of questionnaires into English to maximise the level of consistency.

• Introduce special training for those making the initial telephone call to households.

• Consider using computer assisted personal interview systems to collect information.

The survey tool and methodology chosen for implementing the study have proven to be a relevant instrument for assessing the quality of housing stocks and their impact on health. It is also a novel way that can be explored for identifying priorities in order to support housing policy makers. The results of the analysis of the data collected during this survey will be used for proposing to governments of the European Member States, priorities and evidence on which they could base their housing strategy and policy orientations for achieving the largest health gains for their citizens.

It is a valuable approach for the comprehensive assessment of housing and the cultural, social, and economic status of the surveyed population.

The survey will contribute to the first step towards the calculation of the global burden of disease (GBD) of housing, and will support the work aiming at producing a first version of a causal web for housing and health.

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