WHO HOUSING AND HEALTH GUIDELINES

WHO Housing and health guidelines

ISBN 978-92-4-155037-6

Suggested citation. WHO Housing and health guidelines. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

Editorial consultant: Vivien Stone, Etchingham, UK

Design and layout: L'IV Com Sàrl

Printed in Switzerland

Contents

Foreword vii

Acknowledgements ix

Abbreviations and acronyms xiv

Executive summary xv

1 Introduction 1
1.1 Housing and health 2
1.1.1 WHO approach to healthy housing 2
1.1.2 Key health risks related to housing 2
1.1.3 Prevalence of poor housing conditions 4
1.1.4 Burden of disease associated with housing 5
1.2 WHO Housing and health guidelines 6
1.2.1 Objectives and rationale for developing the WHO Housing and health guidelines 6
1.2.2 Target audience 7
1.2.3 Scope 8
1.2.4 Co-benefits 9
1.2.5 Social determinants, housing and health 10

2 Guideline development process 13
2.1 Contributors to the guidelines 14
2.1.1 WHO Steering Group 14
2.1.2 Guideline Development Group 14
2.1.3 External Review Group 14
2.1.4 Systematic review 15
2.2 Identification of priority questions and critical outcomes 15
2.3 Evidence identification and retrieval 15
2.4 Quality assessment and grading of the evidence 16
2.5 Formulation of recommendations 17
2.6 Decision-making during the GDG meetings 19
2.7 Declaration of interests by external contributors 19
2.8 Document preparation and peer review 20

3 **Household crowding** . . . 21
3.1 Guideline recommendation . . . 23
3.2 Summary of evidence . . . 25
3.2.1 Infectious diseases . . . 25
3.2.2 Non-infectious health disorders . . . 27
3.3 Considerations for implementation of the guideline recommendation . . . 29
3.4 Research recommendations . . . 30

4 **Low indoor temperatures and insulation** . . . 31
4.1 Guideline recommendations . . . 34
4.2 Summary of evidence . . . 35
4.2.1 Respiratory morbidity and mortality . . . 35
4.2.2 Cardiovascular morbidity and mortality: blood pressure . . . 36
4.2.3 Insulation and weatherization . . . 37
4.3 Considerations for implementation of the guideline recommendations . . . 38
4.4 Research recommendations . . . 40

5 **High indoor temperatures** . . . 43
5.1 Guideline recommendation . . . 47
5.2 Summary of evidence . . . 48
5.2.1 Temperature and morbidity . . . 49
5.2.2 High temperature and mortality . . . 50
5.2.3 Relationship between indoor and outdoor temperature . . . 51
5.3 Considerations for implementation of the guideline recommendation . . . 52
5.4 Research recommendations . . . 53

6 **Injury hazards** . . . 55
6.1 Guideline recommendation . . . 58
6.2 Summary of evidence . . . 59
6.2.1 Smoke detectors . . . 59
6.2.2 Stair and safety gates . . . 60
6.2.3 Window guards . . . 60
6.2.4 Fireplace guards, stoves and unprotected hot surfaces . . . 60
6.2.5 Home safety modification programmes . . . 61
6.2.6 Association between the number of hazards in the home and the incidence of injuries . . . 62

6.3 Considerations for implementation of the guideline recommendation . . . 63
6.4 Research recommendations . . . 64

7 Housing accessibility . . . 65
7.1 Guideline recommendation . . . 67
7.2 Summary of evidence . . . 69
7.2.1 Activities of daily living . . . 69
7.2.2 Falls/injuries . . . 70
7.2.3 Mortality . . . 71
7.2.4 Quality of life . . . 71
7.2.5 Psychological effects . . . 72
7.2.6 Participation . . . 72
7.3 Considerations for implementation of the guideline recommendation . . . 72
7.4 Research recommendations . . . 74

8 WHO guidelines for other key housing risk factors . . . 75
8.1 Water . . . 76
8.1.1 WHO Guidelines for drinking-water quality . . . 77
8.2 Air quality . . . 88
8.2.1 WHO Guidelines for indoor air quality . . . 90
8.2.2 WHO Guidelines for ambient air quality . . . 94
8.3 Tobacco smoke . . . 95
8.3.1 WHO Guidelines for indoor air quality: selected pollutants (2010) . . . 96
8.3.2 Protection from exposure to second-hand tobacco smoke: policy recommendations (2007) . . . 96
8.4 Noise . . . 96
8.4.1 WHO Guidelines for noise . . . 97
8.5 Asbestos . . . 100
8.5.1 WHO Guidelines and recommendations for the use of asbestos . . . 101
8.6 Lead . . . 102
8.6.1 WHO Guidelines and recommendations for lead . . . 103
8.7 Radon . . . 104
8.7.1 WHO Handbook on indoor radon (2009) . . . 105
8.8 Additional WHO guidance related to housing . . . 107

9 Implementation of the WHO Housing and health guidelines 109
9.1 Health in All Policies and housing 111
9.2 Co-benefits from multifactorial interventions 113
9.3 Economic considerations for improving housing conditions . . . 115
9.4 Training needs 117
9.5 Dissemination 117
9.6 Monitoring and evaluation: assessing the impact of the guidelines 118

10 Updating and expanding the guidelines 120

References 122

Photo credits 149

Web annex A.
Report of the systematic review on the effect of household crowding on health (WHO/CED/PHE/18.02; http://apps.who.int/iris/bitstream/handle/10665/275838/WHO-CED-PHE-18.02-eng.pdf)

Web annex B.
Report of the systematic review on the effect of indoor cold on health (WHO/CED/PHE/18.03; http://apps.who.int/iris/bitstream/handle/10665/275839/WHO-CED-PHE-18.03-eng.pdf)

Web annex C.
Report of the systematic review on the effect of insulation against cold on health (WHO/CED/PHE/18.04; http://apps.who.int/iris/bitstream/handle/10665/275840/WHO-CED-PHE-18.04-eng.pdf)

Web annex D.
Report of the systematic review on the effect of indoor heat on health (WHO/CED/PHE/18.05; http://apps.who.int/iris/bitstream/handle/10665/275842/WHO-CED-PHE-18.05-eng.pdf)

Web annex E.
Report of the systematic review on the relationship between hazards in the home and injuries (WHO/CED/PHE/18.06; http://apps.who.int/iris/bitstream/handle/10665/275843/WHO-CED-PHE-18.06-eng.pdf)

Web annex F.
Report of the systematic review on potential benefits of accessible home environments for people with functional impairments (WHO/CED/PHE/18.07; http://apps.who.int/iris/bitstream/handle/10665/275844/WHO-CED-PHE-18.07-eng.pdf)

Web annex G.
Estimation of minimal risk and maximum acceptable temperatures for selected cities (WHO/CED/PHE/18.08; http://apps.who.int/iris/bitstream/handle/10665/275874/WHO-CED-PHE-18.08-eng.pdf)

3

Household crowding

3 Household crowding

Household crowding is a condition where the number of occupants exceeds the capacity of the dwelling space available, whether measured as rooms, bedrooms or floor area, resulting in adverse physical and mental health outcomes *(72, 73)*. Crowding is a result of a mismatch between the dwelling and the household. The level of crowding relates to the size and design of the dwelling, including the size of the rooms, and to the type, size and needs of the household, including any long-term visitors. Whether a household is "crowded" depends not only on the number of people sharing the dwelling, but on their age, their relationship and their sex. For example, a dwelling might be considered crowded if two adults share a bedroom, but not crowded if those adults are in a relationship *(74–76)*. Crowding relates to the conditions of the dwelling as well as the space it provides: people may crowd into particular rooms in their home to avoid cold or uninhabitable parts of the dwelling or to save on heating and other costs *(54)*.

The effects of crowding can be broadly defined as the hazards associated with inadequate space within the dwelling for living, sleeping and household activities *(77)*. Crowding is considered to be stressful to health and well-being across different cultures and aspects of life in low-, middle- and high-income countries *(78)*. Several studies have reported a direct association between crowding and adverse health outcomes, such as infectious disease and mental health problems. In addition, researchers have connected crowding to poor educational attainment *(79)*.

Worldwide, crowding is often a marker of poverty and social deprivation *(80, 81)*. It has been identified by the United Nations as one of five deprivations that suggest an informal settlement should be characterized as a slum *(82)*. Crowded households are also often exposed to housing risks discussed in other chapters in the HHGL. For example, the income constraints that compel people to live in dwellings with inadequate space for their needs *(78)* can also mean that such households struggle to afford housing that is in good repair or to heat homes sufficiently *(83, 84)*. In addition, crowding increases exposure to risk factors associated with home injury, social tensions and exposure to second-hand tobacco smoke (SHS) *(85, 86)*.

In order to establish clear guidance on minimizing the health risks associated with crowding, a systematic review of the evidence was commissioned.

Question for the systematic review

In the general population exposed to household crowding, what is the exposure-response relationship between exposure to crowding and the proportion of persons with poorer health compared with the population not exposed to household crowding?

The systematic review focused on the following priority health outcomes:

- close-contact infectious diseases
- gastroenteritis and diarrhoeal diseases
- mental health, including psychological stress
- sleep disturbance.

3.1 Guideline recommendation

Recommendation	Strength of recommendation
 Strategies should be developed and implemented to prevent and reduce household crowding.	Strong

Remarks

- Each Member State should choose an appropriate way to measure the amount of crowding in a household, including a threshold that can be used to define a household as "crowded".
- Implementing agencies can draw on a range of existing measures of crowding (also described as "overcrowding") to determine a measure appropriate to their context (see Table 3.1). Specific guidance exists for emergency shelters *(87)*.[4]
- While the prevalence of infectious diseases varies between countries, the evidence of an association between crowding and adverse health effects is such that implementing agencies should work to reduce crowding regardless of the local prevalence of specific infectious diseases.

[4] Following United Nations High Commissioner for Refugees (UNHCR) standards, emergency shelters located at public buildings are recommended to have 4.5–5.5 m^2 per evacuee (refugee) in cold climates, as residents remain inside the shelters during daytime *(87)*.

Table 3.1 Measures of crowding

UN-Habitat
Overcrowding occurs if there are more than three people per habitable room *(88)*.
American Crowding Index
Crowding occurs if there is more than one person per room; severe crowding occurs if there are more than 1.5 persons per room (excluding bathrooms, balconies, porches, foyers, hall-ways and half-rooms) *(89)*.
Argentinian National Institute of Statistics and Censuses
Overcrowding represents the quotient between the total number of people in the home and the total number of rooms or pieces of the same *(90)*. Households with critical overcrowding are considered those with more than three people per room (excluding the kitchen and bathroom) *(91)*.
Canadian National Occupancy Standard
Overcrowding occurs if extra bedrooms are required to ensure that each of the following have their own bedroom: • cohabiting adult couple • lone parent • unattached household member aged 18 years or over • same sex pair of children aged under 18 years • each additional boy or girl in the household (unless there are two opposite sex children under 5 years, in which case they can share a bedroom) *(75)*.
British Bedroom Standard
Overcrowding occurs if extra bedrooms are required to ensure that each of the following have their own bedroom: • cohabiting adult couple • person aged over 21 years • same sex pair of children aged 10–20 years • two children aged less than 10 years • two children where one is aged 10–20 and one is aged less than 10 years • any other person aged under 21 years that is not paired under one of the preceding categories *(76)*.
Eurostat
Overcrowding occurs if the household does not have at its disposal a minimum number of rooms equal to: • one room for the household • one room per couple in the household • one room for each single person aged 18 years or more • one room per pair of single people of the same gender between 12–17 years • one room for each single person between 12–17 years and not included in the previous category • one room per pair of children under 12 years *(74)*.

- The certainty of the evidence relating to TB and other respiratory infectious diseases was assessed as **high**. The certainty of the evidence relating to gastroenteritis and diarrhoeal diseases, other infectious diseases and to mental health was assessed as **moderate to high.** The certainty of the evidence relating to sleep disorders was assessed as **low**.
- Having considered the certainty of the evidence, the balance of benefits to harms related to reducing crowding, the values and preferences associated with reducing crowding, and the feasibility of reducing crowding, the GDG made a **strong** recommendation.

3.2 Summary of evidence

This section summarizes the evidence from the systematic review on the association between crowding and infectious diseases (including TB, gastroenteritis and diarrhoeal diseases), mental health (including stress) and sleep disorders. The definitions and measures of crowding in the included studies varied and were, for example, based on persons per room, rooms per house, square meterage of living space per person, or living in single or multiple rooms.

The systematic review and the GRADE tables used to present the certainty of the evidence are available online at http://www.who.int/sustainable-development/publications/housing-health-guidelines/en/index.html in Web Annex A.

3.2.1 Infectious diseases

When interpreting the following results, it needs to be considered that the relationship between crowding and infectious diseases depends on the background prevalence of the disease in the specific setting.

Tuberculosis (TB)

Much of the research on the association between crowding and infectious diseases concerns TB.

Twenty-one studies – ten case-control *(92–101)*, eight cross-sectional *(102–109)*, two ecological *(112, 110)* and one retrospective cohort *(111)* – were identified that

related crowding to TB. These studies were consistent in showing that crowding is associated with increased risks of TB, even though the positive association was not statistically significant in a small number of the studies.

Four studies investigated the effect of different levels of crowding on the incidence of TB *(98, 99, 104, 106)*. In these studies, increasing numbers of persons per room were analysed in relation to the incidence of TB. One of these found a significant increase for two to four persons/room in comparison with one person/room but not at greater than four persons/room *(104)*, while the other three studies did not show a statistically significant relationship between increased crowding and the incidence of TB (greater than one and half, greater than two, one to three, three to five persons per room) *(98, 99, 106)*. In the two studies that examined an exposure-response relationship for crowding and TB, one found a consistent relationship *(112)*, but the other did not *(99)*. The 15 other studies used a threshold for crowding, comparing crowded with non-crowded households. Although crowding was not found to have a statistically significant association in four studies *(92, 95, 97, 105)*, crowding was significantly associated with TB in each of the other 11 studies *(93, 94, 96, 100–103, 107, 108, 110, 112)*.

The certainty of the evidence that reducing crowding would reduce the risk of TB was assessed as **high.**

Respiratory diseases (excluding TB)

Thirty studies reporting on outcomes due to respiratory infectious diseases other than TB were included in the systematic review. These investigated flu-related hospitalizations and illnesses: seven studies *(113–119)*; pneumonia: six studies *(120–125)*; acute respiratory illness: 16 studies *(126–141)*; and respiratory syncytial virus: *(142)*. The study designs included 14 cross-sectional, six case-control, five cohort (including a randomized trial in which the intervention was not related to housing, which was an incidental variable) and five ecological studies.

Across the majority of studies on non-TB respiratory diseases, the risk of acquiring the diseases was associated with crowding.

The certainty of the evidence that reducing crowding would reduce the risk of non-TB respiratory disease was assessed as **moderate to high,** depending on the disease**.**

Diarrhoea and gastroenteritis

Thirteen studies – two case-control *(143, 144)*, seven cross-sectional *(145–151)* and four cohort *(152–154, 475)* – were identified that related crowding to diarrhoea or gastrointestinal diseases or parasites, showing that crowding appears to be associated with gastroenteritis and diarrhoeal diseases. Among the included studies, four looked at the effects of different levels of crowding *(145, 147, 148, 155)*. In two of the studies, the higher levels of crowding (greater than three or four people per room) were associated with significantly more cases of diarrhoea compared with the lower levels (less than two or four people per room) *(147, 153)*. In two studies, the level of crowding did not significantly affect the number of cases of diarrhoea, but in one of these studies all levels of crowding were associated with the surrogate outcome of increased intestinal parasite infection *(145)*.

The certainty of the evidence that reducing crowding would reduce the risk of gastroenteritis and diarrhoeal diseases was assessed as **high.**

Other infectious diseases

Twenty-five studies investigated an association between crowding and other infectious diseases such as rheumatic fever and heart disease: five studies *(156–160)*; typhoid fever: one study *(161)*; meningococcal disease: seven studies *(162–168)*; throat eye and skin infections: three studies *(137, 169, 170)*; dengue fever: one study *(171)*; *Helicobacter pylori*: one study *(172)*; methicillin-resistant *Staphylococcus aureus*: two studies *(173, 174)*; parasite *Toxoplasma gondii*: one study *(175)*; Epstein Barr virus: one study *(176)*; neonatal infections: one study *(177)*; multi-drug non-susceptible enteric infections: one study *(178)*; and risk factors for WASH: one study *(179)*. Study designs included ten cross-sectional, nine case control, one ecological and five cohort studies. In general, the risk of acquiring the infectious diseases was associated with crowding.

The certainty of the evidence that reducing crowding would reduce the risk of other infectious diseases was assessed as **moderate to low,** depending on the disease**.**

3.2.2 Non-infectious health disorders

Mental health including stress

Of the 13 separate studies in this category (one of which assessed two different mental health outcomes), eight studies reported at least one

significant association between household crowding and the mental health outcome. A prospective cohort study *(180)*, a retrospective cohort study *(181)* and five cross-sectional studies *(182–186)* all reported that participants living in a crowded household were more likely to report a mental health problem than those not living in crowded conditions. These mental health concerns included: psychological distress, alcohol abuse, feeling depressed and feeling unhappy about one's health. One cross-sectional study further found that crowding was associated with a lower prevalence of psychiatric disability *(187)*.

Four cross-sectional studies could not detect any relationship between crowding and mental health outcomes such as inattention-hyperactivity and emotional symptoms *(130)*, psychological distress *(188)*, suicidal ideation and self-esteem *(189)*, or drug abuse *(186)*. Further, one retrospective cohort study carried out in Israel reported no association between crowding during infancy and development of schizophrenia in later life *(190)* and one cohort study conducted in the United States of America found no link between overcrowding and autonomic nervous system reactivity or externalizing behaviour problems *(474)*.

The certainty of the evidence relating crowding to adverse mental health effects, including stress, was assessed as **moderate to low.**

Sleep disorders

Two recent cross-sectional *(191, 192)* and one ecological study *(193)* investigated the associations between crowding and sleep disorders. One cross-sectional study found excessive daytime sleepiness with greater than one per room *(192)* but the other study concluded that living in a crowded household (greater than or equal to one per room) is not significantly associated with most outcomes relevant to sleep disturbance but did find a significant relationship between crowding and duration of sleep in some analyses *(191)*.

The ecological study found a significant positive relationship between percentage of neighbourhood-level crowding (greater than one per room) and the apnoea–hypopnoea index *(193)*.

The certainty of the evidence that reducing crowding would reduce the incidence of sleep disorders was assessed as **low to very low.**

In summary, the systematic review found high certainty evidence that crowding is associated with an increased risk of TB and diarrhoea. There is moderate to high certainty evidence for a positive relationship between crowding and other respiratory infectious diseases. The certainty of the evidence that crowding is associated with an elevated risk of other infectious diseases and poor mental health is moderate to low; and very low for the linkage between crowding and sleep disorders.

3.3 Considerations for implementation of the guideline recommendation

Reducing crowding has implications for national and local governments, which usually need to build and refurbish housing, subsidize social or public housing, regulate private rental housing, implement tax and planning policies that encourage the building of affordable housing, and work with community leaders in informal settlements. Ensuring housing that is not only available, but also appropriate and affordable, is crucial to reducing crowding. If reducing crowding entails people moving to another location, it might have detrimental effects by removing them from social networks, child care support, and work or educational opportunities, affecting health and earning opportunities *(194, 195)*. If new housing is situated in low-density or sprawling developments, it can reduce physical activity *(196, 197).* If new housing is not affordable, people may have difficulty paying for other essentials including food, energy and health care *(59)*. Therefore, an integrated policy approach, in which reductions in crowding are supported by appropriate rehousing that takes these considerations about potentially unintended effects into account, is fundamental to equity. Reductions in crowding will be most effective if combined with policies that support employment and improve household incomes to increase the affordability of homes with sufficient space. A supportive social welfare system further ensures that loss of job or other income shock does not entail moving into a dwelling with inadequate space in order to reduce costs.

When developing policies to reduce crowding, policy-makers and technical advisors also need to consider the relevance of crowding measures to different subpopulations *(78)*. Depending on the cultural context, an inhabitant's perception of an overcrowded home might vary and different standards to determine adequate housing space might apply. Table 3.1 provides an overview

of different crowding measures that can be applied to assess the prevalence and level of crowding in different settings.

3.4 Research recommendations

The research reviewed shows that crowding is associated with negative health outcomes. However, the study designs, and the close association between social deprivation and crowding, caution against the attribution of causation. The research base could be further strengthened through focusing on the research priorities shown in Table 3.2.[5]

Table 3.2 Research recommendations: crowding

Current state of the evidence	Although there is good evidence on the association between crowding and poor health outcomes, most studies to date are observational and there is considerable heterogeneity in their design. Meta-analysis is difficult because studies define crowding differently, focus on different outcomes and subgroups of interest, and have used different approaches to adjust (or not) for confounding. Further high-quality studies are required, including randomized trials and comparative studies, perhaps using cluster randomized designs. Such studies might test the impact of new housing policies intended to reduce overcrowding, and subsequent effects on health outcomes. Future research should also examine the exposure-response relationships between crowding and health outcomes, including mental health outcomes and intellectual development of children, and make adjustments for confounding. In order to help others to compare, contrast and combine the results of different studies, researchers should use standard and internationally recognized measures of crowding and common approaches to recording and reporting outcomes.
Population of interest	Populations living in residential housing. There is a particular need to understand the effects of crowding on different subpopulations (in particular men, women, children, the elderly, indigenous and at-risk populations).
Interventions of interest	Policies and interventions to reduce crowding, including through extending existing homes, through rehousing and policies that support employment and improve household incomes.
Comparisons of interest	Groups living in crowded and non-crowded home environments; groups before and after interventions to reduce crowding. It is also important to compare the effect on health of people living in different levels of crowding (i.e. "crowding" as opposed to "severe crowding") and people living for different lengths of time in crowded housing (exposure-response relationships).
Outcomes of interest	Key outcomes of interest are TB and other infectious diseases, gastroenteritis and diarrhoeal diseases, sleep quality, intimate partner violence and mental health.
Time stamp	Current systematic review included studies published up to April 2018.

[5] All research recommendations in these guidelines are presented using the EPICOT framework. This summarizes key components of research recommendations under six headings: state of the **E**vidence; **P**opulation; **I**nterventions; **C**omparisons; **O**utcomes (or Outputs); **T**ime st amp.