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# Towards an update of the Italian Ministerial Decree July 5th, 1975

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**Abstract**

*In recent years, the Scientific Community and the Public Health world, in general, have devoted increasing interest to housing conditions, which are considered, to date, one of the main environmental and social determinants of the population's health. In particular, the Scientific Community has identified and studied various indoor well-being factors (e.g. lighting, temperature, ventilation, air quality, etc.). Some of these factors have been regulated by laws and regulations at various levels: the availability of clear and updated health requirements dictated by the regulations is fundamental to effectively protect public health, especially in confined environments. In the present work, we propose a revision of the Italian Ministerial Decree of July 5th, 1975 titled Modificazioni alle istruzioni ministeriali 20 giugno 1896 relativamente all'altezza minima ed ai requisiti igienico sanitari principali dei locali d'abitazione (Modifications to the ministerial instructions of June 20th, 1896 regarding the minimum height and the main hygienic-sanitary requirements of living spaces) in order to update the definition of the essential elements that qualify a space as habitable from the hygienic-sanitary point of view, taking into account the evidence gathered from the technical and scientific literature on the requirements and contents of the Building Codes of the major European countries.*

## Foreword

The "United Nations High Commissioner for Housing" affirms the principle of *habitability*, understood as "*providing the inhabitants with adequate space and protecting them from cold, damp, heat, rain, wind or other threats to health, structural hazards, and disease vectors*" (1). The World Health Organization (WHO) (2), reaffirming this principle, has recently published guidelines on "Housing and Health", which provide recommendations to promote healthy housing and a sustainable and equitable future. Governments have an obligation to take measures to ensure that all people are able

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to fully attain their rights, including the right to habitable housing. Currently, in Italy, a considerable amount of housing, especially social or rented housing, does not adequately meet these recommendations (3, 4). Regarding the size, ISTAT (Italian National Institute of Statistics) reports that more than a quarter of the Italian resident population lives in overcrowded conditions (5) and 20% of dwellings show problems of deterioration due to dampness, and significant structural problems (4). These problems are much more prevalent if we refer to the immigrated population (3, 6).

In recent years, housing conditions have been the subject of increasing interest from the scientific community and public health, so much that today they are considered one of the main environmental and social determinants of the population health (7). Its importance is due to a number of factors, including: concern about indoor exposures (8); the accumulation of scientific evidence on the health impact of inadequate dwellings, unable to cope with the new needs induced by climate change and population ageing; the obsolescence of many buildings (9, 10); the recovery for housing purposes of spaces unsuitable because of location and size (e.g. shops, basements, etc.) (11, 12). The recent pandemic has also highlighted the health value of living space from the point of view of physical health (e.g. problems related to overcrowding) and mental health (e.g. lack of privacy for study, work, relaxation or leisure time, children's play, etc.) (13, 14).

In particular, as far as indoor well-being factors are concerned, over the last two centuries the Scientific Community has identified and studied several of these factors (15), which have been accurately reflected in various documents produced by WHO and reiterated in its recent guidelines on the subject (2). These include artificial lighting and sunlight, temperature, humidity and air velocity, air exchange, also in relation to the presence of physical, chemical and biological pollutants (radon, thorium, volatile organic compounds – VOCs -, microorganisms, etc.). Some of these factors have been regulated by laws and regulations at various levels: the availability of clear and updated health requirements dictated by these regulations is fundamental to effectively protect public health in a confined environment (16, 17) and, more generally, in the urban environment (18, 19).

Therefore, we feel that time has come for a proposal of renovation of the Italian Ministerial Decree of July 5th, 1975 "Modificazioni alle istruzioni ministeriali 20 giugno 1896 relativamente all'altezza minima ed ai requisiti igienico sanitari principali dei locali d'abitazione" (Modifications to the ministerial instructions of June 20, 1896 regarding the minimum height and the main hygienic-sanitary requirements of living spaces). The proposal to renovate this Decree, reported in the following Tables 1 to 6, was carried out taking into account the evidence obtained from the technical and scientific literature on the hygienic-sanitary requirements of the houses and the contents of the Building codes of the main European countries, and provides for the amendment and/or integration of the decree with some articles dealing with issues deemed relevant to the indoor well-being of the occupants.

In addition, the recent publication of the Standard Building Regulations (*Regolamento Edilizio-Tipo - Intesa Stato Regioni e ANCI* of 20.10.2016) (20), which also provides for the definition of health and hygiene requirements, represents an opportunity to review and update, where possible, the contents of the Ministerial Decree of 5th July 1975, with focus on performances.

Some fundamental areas of the 1975 MD, such as heating and mechanical ventilation systems, for example, have also been reformulated, taking into account recent technological innovations and focusing on the comfort needs of users.

## Description of the rationale of the proposed update

Tables 1 to 6 show the contents of the Ministerial Decree 5th July 1975 on "*Modificazioni alle istruzioni ministeriali 20 giugno 1896 relativamente all'altezza minima ed ai requisiti igienico sanitari principali dei locali d'abitazione*" (*Amendments to the Ministerial Instructions of 20th June 1896 regarding the minimum height and the main hygienic-sanitary requirements of the living space*) and, in the added column, for each requirement defined by the Ministerial Decree, a proposed update has been inserted. As evidenced by the following tables, some articles have been simplified and/or integrated, and others, not present in the 1975 Decree, have been added. Below is a description of the rationale for each considered parameter (health impacts).

## Housing size

The first aspect dealt with is the living space (Tab. 1), which should guarantee the full psycho-physical well-being of the occupants. The living space, according to the WHO, must be such as to adequately meet the privacy needs of the occupants, be accessible and usable for an extended user base and be large enough to comfortably accommodate people of different ages (21, 22).

In general, the Ministerial Decree 5th July 1975, providing minimum size parameters for housing among the widest compared to other countries, defined criteria for the livability of spaces that were more conservative even for the most fragile socio-economic classes. However, these standards must be adapted functionally to the new living needs (23).

In fact, the health impacts of inadequate living space are diverse. Some are associated with overcrowding, others with accessibility and safety (2). In many studies, a significant association between domestic overcrowding and mental health problems has been highlighted (24). Such problems include mental and psychological distress, addiction, social isolation (25). Reinolds et al. (26) also documented that living in cramped dwellings may damage family relationships, negatively affecting children's upbringing and causing anxiety, stress and depression.

Inadequate living space, leading to situations of overcrowding, can also play an important role in the spread of infectious diseases, in relation to the underlying prevalence of the disease in the territorial context. With regard to airborne infections, much of the research refers to tuberculosis, a disease whose association with overcrowding is well documented (27-29). The social distancing imposed by the recent COVID-19 pandemic has emphasized these problems: the only place people could stay was their own home, reaching values close to 100% of the time for the majority of the Italian population and creating considerable inconvenience, especially in homes with less space available per inhabitant (14).

Overcrowding is the result of a discrepancy between the dwelling and the family. The level of overcrowding refers to the size and design of the dwelling, including the size of the rooms, as well as the type, size and needs of the family. At the same time, as pointed out by WHO (*Housing and Health Guidelines*), several studies have reported a direct link between overcrowding and mental health problems. These problems occur mainly in the low-income section of the population, leading to clear health inequalities (13). Overcrowding has also been linked to faeco-orally transmitted infections (30), due to the difficulty in maintaining cleanliness in too little space.

Another implication of living space concerns *accessibility*. In Italy about 3.2 million individuals, of whom 2,500,000 are elderly, suffer from disabilities. In the light of current

Tab. 1 – Housing size

| **MD 5th July 1975** | **Text of revision and integration of MD 5th July 1975** |
|---|---|
| | **Art. 0. Spaces of life**<br>*Performance targets*<br>• Provide for a sizing of the premises, air volume and suitable air exchange to ensure the full psychophysical well-being of the occupants.<br>• Reduce social inequalities by ensuring suitable minimum living space for the occupants of each housing unit.<br><br>*Performance*<br>• Guarantee full usability and accessibility of the spaces as provided for by the regulations in force.<br>• Ensure the presence of spaces for use as bedroom, living room (functional layout) and utility rooms within each accommodation.<br>In new housing models dictated by emerging socio-economic needs (e.g. co- housing), utility rooms (e.g. laundry, kitchen, etc.) and additional common socialising spaces can be provided. |
| **Art. 1. Minimum internal height of the dwellings**<br>The minimum useful internal height of living quarters is fixed at<br>2.70 m, which can be reduced to 2.40 m for corridors, hallways in general, bathrooms, toilets and storerooms.<br>In municipalities higher than 1,000 m. above sea level, a reduction of the minimum height of the habitable rooms to 2.55 m[1]. may be allowed, taking into account the climatic conditions and the local building typology. | **Art. 1. Minimum internal height of the dwellings**<br>• The minimum useful internal height of the primary rooms should be no lower than 2.70 m. The primary rooms are the spaces intended for living room, kitchen, bedrooms, rooms for uses other than the continuous presence of persons.<br>• The minimum useful internal height of the ancillary rooms should be no less than 2.40 m. Ancillary spaces are spaces for sanitary facilities, bathrooms, hallway, storage room, corridor, other spaces without continuous presence of persons.<br>• In municipalities higher than 1,000 m. above sea level, a reduction of the minimum height of the habitable rooms to 2.55 m. may be allowed, taking into account the climatic conditions and the local building typology[2]. |

[1] **Text of MD 5th July 1975:** The minimum heights provided for in the first and second paragraphs may be derogated from within the limits already existing and documented for the living quarters of buildings located in mountain municipalities subject to building restoration and improvement of hygienic-sanitary characteristics when the building has specific typological characteristics of the place worthy of conservation and provided that the request for derogation is accompanied by a renovation project with alternative solutions to ensure, in any case, in relation to the number of occupants, suitable hygienic and sanitary conditions of the accommodation, which can be achieved by providing for a larger surface area of the accommodation and living spaces, or the possibility of adequate natural ventilation favoured by the size and type of windows, by cross draughts and by the use of auxiliary natural ventilation means.

[2] Text of the Ministerial Decree of 5th July 1975 revised and integrated: The minimum heights provided for in the first, second and third points may be waived within the limits already existing and documented for the living quarters of buildings located in mountain municipalities subject to building restoration and improvement of hygienic and sanitary characteristics, when the building has specific typological characteristics of the place worthy of conservation. Such exceptions are foreseeable on condition that the request is accompanied by a renovation project with alternative solutions to guarantee, in any case, in relation to the number of occupants, suitable hygienic and sanitary conditions of the accommodation. These can be obtained by providing for a larger surface area of the accommodation and the living spaces, or the possibility of adequate natural ventilation, favoured by the size and type of windows, the transverse air strikes and the use of auxiliary natural ventilation.

| | |
|---|---|
| **Art. 2. Floor space**<br>Each inhabitant must have a living area of no less than14 m$^2$ for the first 4 inhabitants and 10 m$^2$ for each further occupant. The bedrooms must have a minimum area of 9 m$^2$ for one person and 14 m$^2$ for 2 persons.<br>Each dwelling must be equipped with a living room of at least 14 m$^2$. The bedrooms, living room and kitchen must have an opening window. | **Art. 2. Floor space**<br>• For each inhabitant, a living area of not less than 14 m$^2$ for the first 4 inhabitants and 10 m$^2$ for each further occupant must be ensured.<br>Suitable living spaces must be provided inside each accommodation, through appropriate functional layouts and design solutions and, in particular, by guaranteeing the furnishability of these spaces and promoting their internal accessibility, at least in terms of adaptability in accordance with the regulations in force.<br>• For each accommodation, at least one bathroom must be equipped with the following sanitary facilities: toilet, bidet, bathtub or shower, washbasin. |
| **Art. 3. Single-room accommodation**<br>Still respecting the minimum internal height of 2.70 m., except for municipalities located 1,000 m. above sea level or higher, for which the reduced measures already mentioned in Article 1 apply, single-room accommodation, must have a minimum area, including ancillary spaces, no less than 28 m$^2$, and no less than 38 m$^2$ if for two people. | **Art. 3. Single-room accommodation**<br>• Still respecting the minimum internal height of 2.70 m., except for municipalities located 1,000 m. above sea level or higher for which the reduced measures already mentioned in art. 1 apply, single-room accommodation must have a minimum surface area, including ancillary spaces, of no less than 28 m$^2$ for one person, and no less than 38 m$^2$ for two people; and must enable, after the arrangement of common furniture and bed, the mobility of disabled people or potentially similar (elderly people, carriers of chronic degenerative diseases, etc.). |
| **Art. 7 Bathroom**<br>The bathroom must be provided with an opening to the outside for air exchange or be equipped with a mechanical suction system. The installation of open flame appliances is prohibited in bathrooms that do not open to the outside.<br>For each accommodation, at least one bathroom must be equipped with the following sanitary facilities: toilet, bidet, bathtub or shower, washbasin. | Partly included in Article 2. Floor space and partly in Article 5. Natural ventilation and CMV (Controlled Mechanical Ventilation) systems. |

demographic trends, it has been estimated that every new home is 60% likely to be occupied by a person with a functional disability over the course of their lifetime (31). In general, people with functional disabilities living in accessible home environments are more able to perform daily activities and manage life independently.

Milner and Madigan (32) observed that, in light of changing social needs, greater flexibility in housing is required in order to meet the needs of a wider population. *Flexibility* can also help to manage epidemic situations, allowing for the isolation of individuals, ensuring adequate privacy for study, remote working, relaxation and play for children, but also more space to ensure the mobility of wheelchairs or other aids to care for the elderly, etc. (13, 14).

Therefore, while confirming the living area and volume provided for in the 1975 Ministerial Decree, the proposed update (Tab 1) includes an article (Art. 0) that introduces the general concept of *living spaces,* defining performance objectives (room sizing, air volume and air changes) and minimum performance (usability, accessibility and furnishability).

## Thermal comfort

The article "heating systems" is reworded (Tab. 2), in terms of performance, as "Thermo-hygrometric comfort". This article includes all the relevant microclimatic parameters required in the design of an indoor space with suitable conditions of well-being and satisfaction on the part of the occupants.

The theme of thermal well-being has been the subject of numerous researches that have documented the close relationship between the physical components of microclimate (temperature, radiation, humidity and ventilation), psycho-physical well-being and the level of performance of the inhabitants (33). All microclimatic parameters contribute to the satisfaction of the state of well-being and are therefore a priority in the design of an *indoor* space. The variation of each of them can therefore contribute to the onset of physical and psychological symptoms that must be avoided.

It has been shown that unfavourable thermo-hygrometric conditions are associated with various symptoms such as itching, tearing, headache and throat irritation for occupants (34). Relative humidity is very important because it is closely related to temperature: in fact, at high values, it increases the perception of both heat and cold, causing possible feelings of discomfort. In conditions of relative humidity below 20%, the presence of dust in the air, suspended bacterial loads and possible electrostatic charges increases, moreover, skin and mucous membranes dehydrate, and the risk of infection increases due to a reduction in the barrier film. Conditions of high temperature, with relative humidity above 60% and insufficient air exchange favour the proliferation of germs and the development of moulds, responsible for the onset of allergic and inflammatory diseases, as better described in the section on indoor air. The most common health effect associated with mould contamination is asthma. Those most vulnerable are infants, children, the elderly and people with compromised immune systems (35).

The Environmental Protection Agency (EPA) has estimated that exposure to moisture and moulds in residential environments contributes to 21% of asthma cases in the USA each year (36). This exposure has also been positively associated with the development of hypersensitivity pneumonia, allergic rhinitis, eczema, bronchitis and lung cancer (37-39).

Air velocity induces a dissipation of body heat: at high temperatures and low air velocity this process is not performed, with consequent effects on health; on the other hand, at excessive velocities, higher than 1.5 m/s, it can cause a feeling of discomfort. The average radiant temperature, when not adequately considered, can cause discomfort even with optimal air temperature values. In fact, in the presence of a non-uniform radiant field, the different parts of the body unevenly exposed will presumably take on different temperatures, causing a feeling of discomfort. Low temperatures in indoor environments often depend on the outside temperature due to structural deficiencies in the building (lack of insulation, heating, etc.) (2).

Much of the evidence on health impacts attributable to low temperatures in indoor environments tends to focus on increased blood pressure, asthma and mental health problems. In winter, cold houses contribute to excessive mortality and morbidity. For older people, most of the health burden can be attributed to respiratory and cardiovascular diseases. For children, the excess health burden in winter is largely due to respiratory diseases (2).

The annual burden of diseases due to staying in inadequately heated environments can be estimated, compared to available data, at 30% of excess deaths during the winter season in the 11 European countries selected (40).

Tabella 2 - Thermal comfort

<table>
<tr><th>MD 5th July 1975</th><th>Text of MD 5th July 1975 revised and integrated</th></tr>
<tr><td>

**Art. 4. Heating systems**

The accommodation must be equipped with heating systems where climatic conditions so require.<br>
The design temperature of the indoor air must be between 18°C and 20°C; it must comply with these values and must be the same in all inhabited areas and ancillaries, excluding closets.<br>
Under the conditions of occupation and use of the accommodation, the internal surfaces of the opaque parts of the walls must not show any traces of permanent condensation.

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**Art. 4. Thermo-hygrometric comfort**

The accommodation must be equipped with heating and/or cooling systems where climatic conditions so require.

*Performance targets*

- In order to ensure adequate thermo-hygrometric comfort it is necessary to:
- – ensure relative temperature stability, both between day and night, between summer and winter, and between floor and ceiling (<3°);
- – maintain a certain homogeneity of temperature minimising thermal gradients between indoors and outdoors and between different indoor environments;
- – maintain conditions of air velocity and relative humidity such as to ensure the well-being of the occupants;
- – ensure that there are no traces of infiltration and permanent condensation on the internal surfaces of the opaque parts of the walls, under the conditions of occupation and use of the accommodation.

*Performance*

<table>
<tr><th>Parameters</th><th>Summer</th><th>Winter</th></tr>
<tr><td>Operating temperature[3]</td><td>Excellent (Class A)*: 24°C +1°C</td><td>Excellent (Class A)*: 22°C +1°C</td></tr>
<tr><td></td><td>Good (Class B)*: 24°C +2°C</td><td>Good (Class B)*: 20°C +2°C</td></tr>
<tr><td>Air velocity</td><td>Excellent (Class A)* < 0.12 m/s<br>Good (Class B)*: < 0.19 m/s</td><td>Excellent (Class A)*: < 0.1 m/s<br>Good (Class B)*: < 0.16 m/s</td></tr>
<tr><td>Relative humidity</td><td>50%< UR <60%</td><td>40%< RH <50%</td></tr>
</table>

*Excellent is equivalent to Class A and Good to Class B of UNI EN ISO 7730:2006

- Guarantee, in the specific case of solar greenhouses, both adequate levels of thermo-hygrometric comfort and the frames' ability to open.
- Ensure adequate maintenance of the plants in accordance with the provisions of the guidelines, technical standards, regulations and legislation in force.
- Identify technical and locational solutions for the installation of systems and ducts that minimise disturbance to residents and to visual impact.

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</table>

[3] The Presidential Decree 74/2013 indicates the following temperature values: 20°C +2°C (max tolerance) for winter; 26°C -2°C (min tolerance) for summer. It is also necessary to consider specific national and regional indications that take into account the different climatic zones of the territory. Therefore, the reported UNI EN ISO 7730:2006 values have to be considered a general indication that can be modified on the basis of regional indications.

Compared to indoor environments with excessively high temperatures, there is evidence of increased symptoms related to 'Sick Building Syndrome', (negative moods, irregular heart rate, difficulty breathing and fatigue) (35). People, especially the elderly, who spend much of their time indoors without air conditioning, are more exposed to increased risk from high temperatures indoors during the summer period; protection from high temperatures becomes a key feature of healthy living (2). According to WHO "there is no demonstrable risk to human health of healthy sedentary people living in air temperature of between 18 and 24° C" (41).

## Natural lighting

The theme of lighting has been reviewed under a performance perspective (Tab. 3): from the evaluation of the windowed surface area to the objective measurement of the quantities of light actually present in the environment (calculation of the daylight coefficient).

The amendment of this article aims to ensure the environmental conditions of visual well-being and reduce the use of artificial lighting sources, optimising the exploitation of natural light and saving energy. Natural lighting is identified as a resource and a determining factor for health (42).

Natural lighting and sunlight are of great importance for health and hygiene (43). Solar radiation - thanks to its infrared and ultraviolet components - has both an effective antibacterial action and an important action on the human organism from a physiological, therapeutic and psychological point of view (44). It also has a stimulating effect on many functions of metabolism, such as the formation of vitamin D and pigmentation of the skin, and acts as a therapeutic adjuvant in tubercular states, anaemia, rickets, lymphatism (45).

Natural light is also essential for visual well-being. Sight, responsible for the highest number of sensations and perceptual stimuli that we store from the outside, is the sense on which we rely most in reading the world and which most influences humans through the central nervous system. As is well known, vision occurs thanks to certain retinal photoreceptors, which convert light energy into electrical signals that initiate vision, transmitting information through multisynaptic pathways to the retinal ganglion cells (RGC), which innervate different areas of the brain for complex visual processing. Some of these cells, called ipRGCs (*intrinsically photosensitive Retinal Ganglion Cells*), do not process visual information, but carry stimuli - activated directly by light - that can synchronise circadian rhythms (by regulating the hormone melatonin, responsible - together with cortisol - for sleep-wake rhythms) and keep track of seasonal changes (6). Some possible negative effects of insufficient natural lighting can be: rickets, osteoporosis, weakening of the immune system, melancholy, altered production of hormones (melatonin, cortisol, etc.), altered circadian and sleep rhythms, winter depression. SAD (*Seasonal Affective Disorder*) represents a situation in which people, who have a normal level of mental health for most of the year, experience depressive symptoms in winter or summer (46). In Europe, it affects 1.3-3% of the population (47). Improper exposure to indoor lighting can also adversely affect work performance and the physical and psychological condition of the user (48).

As part of the LARES (*Large Analysis and Review of European Housing and Health Survey*) study sponsored by WHO (49), a cross-sectional survey covering the health status of 8,519 people living in 3,373 homes in eight European cities, researchers found a link between inadequate natural lighting in the home and increased risk of depression and falls. This association remained statistically significant even after checking for possible confusing variables.

Tabella 3 - Natural lighting

| DM 5th July 1975 | Text of MD 5th July 1975 revised and integrated |
|---|---|
| **Art. 5. Direct natural lighting**<br><br>All accommodation spaces except those used for sanitary facilities, hallways, corridors, stairwells and storerooms must have direct natural lighting appropriate to their intended use.<br>For each room, the window width must be proportionate to ensure an average daylight factor value of not less than 2%, and in any case the window opening area must not be less than 1/8 of the floor area.<br>For buildings included in public residential construction, it is necessary to ensure, on the basis of the above provisions and of the results and rational experiments, the adoption of unified sizes of windows and, therefore, their frames. | **Art. 6. Natural lighting**<br><br>*Performance targets*<br>• Provide direct natural lighting appropriate to the intended use to all accommodation spaces except, where not possible, those intended for utilities (bathrooms, hallways, corridors, stairwells and storerooms).<br>• Ensure sufficient artificial lighting for the hours of darkness and for any rooms that are not naturally illuminated, both in the home and in common areas and spaces close to the entrance to the home.<br>• For common areas and spaces close to home access, the use of low-consumption artificial lighting compatible with the well- being of the occupants is preferred.<br><br>*Performance*<br>• Ensuring an average daylight factor (ADF) value of not less than 2% for habitable rooms |

## Ventilation and reduction of indoor pollution levels

The theme *of mechanical ventilation* is reformulated (Tab. 4), from a performance point of view, and integrated with appropriate indications on natural ventilation and air changes, taking care to limit chemical and biological pollution, also through the use of design strategies for natural ventilation and a correct and sustainable design of Controlled Mechanical Ventilation (CMV) systems. In revising the 1975 Decree, it has also been proposed to integrate the issue of exposure to indoor chemical pollution (Tab. 4), a very important aspect present in the regulations of several European countries (50).

It is possible, in fact, to improve the air quality in indoor environments through the proper use of building materials, coatings and furniture, as well as adequate ventilation.

The problems related to indoor pollution affect the entire exposed population, but the phenomenon is especially relevant for the more fragile subjects, such as the elderly, children and individuals already suffering from chronic diseases (heart disease, respiratory diseases, bronchial asthma, allergies), who spend most of their time in homes and schools (51). Some studies show that children are particularly sensitive to inadequate air quality due to the small size of their airways and higher ventilation rates than adults (52).

In particular, it has been highlighted that some indoor pollutants are able to contribute to the increase of the incidence of various acute and chronic diseases, from irritation or disturbances of the sensory system to malignant tumors (51). Concentrations of indoor pollutants are often higher than the outdoor ones (United States Environmental Protection Agency - USEPA) (53) and exposure to them has been repeatedly associated with asthma, allergies, bronchitis, especially in Western countries (54).

*Chemical pollutants* – The Volatile Organic Compounds (VOCs) have very diverse intrinsic characteristics and impacts in relation to environmental persistence, toxicity, olfactory threshold etc. VOCs, some of which are carcinogenic to humans (International Agency for Research on Cancer - IARC: Group 1), include formaldehyde, benzene and trichloroethylene emitted by many materials and products (paints, solvents, adhesives, furniture and furnishings, polyurethane foams, cosmetics, deodorants, cleaning products, etc.) (55-57), as well as combustion processes and tobacco smoke (58).

For *MMVFs* (Man-Made Vitreous Fibres), the criteria for classification of carcinogenicity must take into account the fibre diameter and the presence of alkaline and alkaline-earth oxides. In general, the IARC, as part of its programme for the reassessment of carcinogenic risks related to mineral wools, has decided that mineral wools are not to be considered as carcinogen, while it has classified ceramic fibres in the group of possible carcinogens (59).

*Radon* **-** Radon is classified by IARC as a definite human carcinogen (Group 1) in relation to lung cancer. Recent case- control studies have shown that residential exposure to Radon is the leading cause of lung cancer after exposure to tobacco smoke (8-15% of the attributable risk in Europe and North America) (60-62). The increase in risk is proportional to the level of exposure: therefore, interventions aimed at reducing medium-low concentrations of Radon are also justified (61-63).

As a gas, Radon is evenly distributed in the air of a room while its decay products stick to the particulate matter (dust, aerosols) of the breathed air and then settle on the surfaces of walls, objects, etc. Most of the inhaled Radon is exhaled before it decays (but a small amount is transferred to the lungs, blood and, therefore, to the other organs), while the decay products stick to the walls of the respiratory system and here they irradiate (through alpha radiation) the cells of the bronchi, thus expressing their harmful action (6).

*Damp and mould* **-** Exposure to damp is an important risk factor for asthma and other respiratory conditions, both among sensitized and non-sensitized individuals (34). Moulds can also produce irritants, including spores and microbial volatile organic compounds (MVOCs). The latter, responsible for the odour of mould, may contribute to the adverse health effects of exposed individuals. Exposure to moulds has been positively associated with asthma, hypersensitivity pneumonia, allergic rhinitis, eczema, toxic mould syndrome, bronchitis and lung cancer development (37).

The prevention of indoor pollution underlines the importance of ensuring good indoor air quality through natural ventilation of the rooms, exploiting the external environmental conditions and the distribution characteristics of the spaces and possibly improving their characteristics through the use of controlled mechanical ventilation systems.

In buildings with inadequate ventilation, air quality is often reported as suffocating and unpleasant. This makes the indoor environment unsuitable for the occupants to stay in and, moreover, the pollutants present could lead to a number of health risks (35). Indoor pollution is certainly one of the most significant risk factors in recent decades (6). As described above, the pollutants that can be found in buildings are diverse in nature and many are often present in indoor environments in concentrations that are hazardous for long-term exposures; for this reason, the air changes in a room are particularly important for the protection of health.

The pollutants present in indoor environments, associated with poor ventilation, can be the cause of a wide range of manifestations, ranging from a feeling of unease and discomfort, to even serious diseases, which are usually divided into two groups, based on epidemiological, etiopathogenetic, clinical, diagnostic and prognostic considerations.

Tabella 4 - Reduction of indoor pollution levels and Ventilation

| DM 5th July 1975 | Text of MD 5th July 1975 revised and integrated |
|---|---|
| **Art. 6. Mechanical ventilation** | **Art. 5. Natural Ventilation and Controlled Mechanical Ventilation (CMV) systems** |
| When the typological characteristics of the dwelling give rise to conditions that do not allow natural ventilation, centralized mechanical ventilation must be used, introducing appropriately captured air with appropriate hygienic requirements.<br>In any case, fumes, vapours and emissions must be drawn in at the production points (kitchens, toilets, etc.) before they spread.<br>The 'cooking station', which may be attached to the living room, must be accessible from the living room and must be adequately equipped with a forced extraction system on the cooker. | *Performance targets:*<br>• Have a natural ventilation guaranteed through a suitable air exchange obtainable through openable windows and adequate design solutions.<br>• Use controlled mechanical ventilation when the typological characteristics of the dwelling give rise to conditions that do not allow the use of adequate natural ventilation, introducing properly captured air with appropriate hygienic-sanitary requirements.<br>• Improve comfort conditions and indoor air quality taking care to limit chemical and biological pollution, also through the use of design strategies for natural ventilation and a correct and sustainable design of CMV systems.<br>• Favour adjustable CMV (Controlled Mechanical Ventilation) systems in order to balance comfort conditions and indoor air quality with the number of occupants and/or non-work activities that may be performed.<br>• Limit heat loss, noise, energy waste, external entry of pollutants (e.g. VOCs, polycyclic aromatic hydrocarbons PAHs, particulate matter $PM_{10}$, $PM_{2.5}$, pollen, insects, etc.) and hot air in the summer months, by adopting suitable ventilation and filtration systems.<br><br>*Performance*<br>• Guarantee ventilation values higher than 0.5 vol/h during room occupancy (0.7 vol/h for category I, 0.6 vol/h for category II, 0.5 vol/h for category III) (UNI EN 15251-2008).<br>• Ensure the suction of fumes, vapours and emissions at production points (kitchens, toilets, etc.) before they spread.<br>• Identify technical and locational solutions for the installation of systems and ducts that minimise disturbance to residents and visual impact, bearing in mind that all ducts for conveying vapours, fumes or other emissions into the atmosphere must comply with the reference technical standards.<br><br>Specific needs<br>• Provide a "cooking station", possibly attached to the living room, with a suitable forced extraction system on the cooker.<br>• Equip the first bathroom with natural ventilation and/or CMV systems; secondary bathrooms, if without opening windows, must be equipped with forced ventilation systems that guarantee at least 5 spare parts per hour.<br>• Provide for an increase in ventilation through CMV systems in dwellings where average annual indoor concentrations of radioactivity ≥100 $Bq/m^3$ are detected. This performance must also be met in basement, cellar, and ground floor rooms. |

| | |
|---|---|
| | **Art. 7. Reduction of indoor chemical pollution levels**<br><br>*Performance targets*<br>• Ensure indoor air quality levels compatible with the well-being of the occupants.<br>• Ensure suitable ventilation/number of air changes.<br>• Ensure adequate ventilation/number of air changes in accordance with Art. 5. Natural ventilation and CMV.<br><br>*Performance*<br>• Ensure a concentration of indoor pollutants in all rooms, including VOCs (e.g. benzene, formaldehyde, trichloroethylene, tetrachloroethylene, etc.), PAHs (e.g. benzo(a)pyrene), carbon dioxide and carbon monoxide, below or equal to the WHO guideline values in 2010. |

To the first group belongs the so-called Sick Building Syndrome (64), characterised by a symptomatology of modest entity, nonspecific and polymorphous (headache, drowsiness, eye and skin irritation, throat irritation, cough, shortness of breath, sinus congestion, dizziness, nausea, etc.) closely related to the person's stay in the building, which is resolved or quickly diminished when he/she is removed from it (65).

The second group includes diseases with a well-defined clinical picture, which are not resolved by leaving the unhealthy place, and whose pathogenesis is allergic, toxic or infectious, and sometimes considerably serious (66).

An increasing number of studies have shown that workers or students who carry out activities in environments with adequate air quality are more productive and healthier than those who work in poorly ventilated spaces (67). Poor ventilation, in fact, has been associated with increased absenteeism from work and school, lower productivity and higher operating costs (68).

## Non-ionising radiation

Another important aspect that should be introduced into the text of the 1975 MD is that relating to protection against non-ionising radiations (Tab. 5).

Attention is paid to this issue in order to: minimise the exposure of the population to radio frequencies (RF), both Electromagnetic fields with high frequency (EMF-RF) and low frequency (EMF-ELF). In fact, household appliances, landlines and mobile telephones, the Internet, etc. are all services that are now essential for daily living that work thanks to electromagnetic fields.

The biological effects of non-ionizing radiation are divided into short-term effects and long-term effects.

The former depend on the intensity, the amount of energy absorbed by the irradiated tissue or organ, the frequency of radiation and the mode and time of exposure. Short-term effects may be thermal or non-thermal. Weak EMFs mainly produce perceptual or sensory effects by stimulating sensory organs, nerves and muscles (e.g. nausea, dizziness, phosphenes, etc.). More intense EMFs produce more serious responses (e.g. alteration of blood flow in the limbs, heart or brain function; tingling sensation or nerve stimulation pain; muscle contractions; overheating or localised or whole-body burns; localised heat damage to the eyes or skin, etc.). In order to any response to occur, at any frequency, it is necessary to exceed an

Tab. 5 - Non-ionising radiation

| MD 5th July 1975 | Text of MD 5th July 1975 revised and integrated |
|---|---|
| | **Art. 8. Protection from non-ionising radiation: electromagnetic pollution**<br><br>*Performance targets (to be applied for renovations and new builds)*<br>• Take steps to reduce the intensity, duration and level of exposure.<br>• Optimise the design of installations and the layout of electrical appliances in long-stay environments (more than 4 hours/day) in order to reduce the level of exposure of residents.<br><br>*Performance*[4]<br>• The epidemiological evidence available, while showing excessive risk for several diseases, does not enable a definition of an acceptable exposure level; therefore, the suggestion is to adopt the Precautionary Principle by reducing the exposure in living environments to the lowest possible values[5]. |

exposure threshold value, below which there is no risk and exposures below the threshold are not cumulative in any way. This means that there can be no further health risks once the exposure has ended (69).

With regard to long-term effects, several epidemiological studies have investigated the correlation between exposure to EMF at 50Hz and RF and health effects. After reviewing and evaluating the available scientific literature, the IARC has classified both EMF-ELF (70) and RF (71) in group 2b "possible human carcinogens" in relation to the onset of childhood leukaemias for the former and acoustic neurinoma and glioma for the latter. Therefore, although it is not yet possible to speak of a cause-and-effect relationship or to know the threshold values below which no damage will occur for certain, it is appropriate, in view of the results of epidemiological studies, to adopt a precautionary approach based on the precautionary principle, as set out in Article 174 of the Treaty establishing the European Union, seeking to minimise the population's exposure (65).

## Acoustic well-being

Finally, the noise protection aspect has been revised in terms of performance, indicating the acceptability limits provided for by the current legislation (Tab. 6).

To ensure acoustic well-being in indoor environments it is necessary to ensure a suitable acoustic climate (outdoor environment), to minimise the acoustic impact caused by production, commercial, service, recreational or other activities that generate noise, and, above all, to minimize the transmission of noise from the external environment to the indoor environments, between adjacent environments: the noise produced by footfalls and technical systems (passive acoustic requirements) (72).

Noise is nothing more than an audible sound that can cause disturbance, but also impairment or damage to health. An unfavorable acoustic environment is detrimental to health, quality of life and relationships. According to the first report on the health impact of noise in Europe (73), noise is

[4] For the choice of the most suitable measures to be taken, please refer to the document "Good health practices and performance targets for building and renovating residential buildings" Project CCM 2015

[5] http://www.salute.gov.it/portale/news/p3_2_3_1_1.jsp?lingua=italiano&menu=dossier&p=dadossier&id=7

Tab. 6 - Acoustic well-being

| **MD 5th July 1975** | **Text of MD 5th July 1975 revised and integrated** |
|---|---|
| **Art. 8. Noise protection**<br><br>The materials used for the construction of dwellings and their installation must provide adequate sound protection for the rooms with regard to footfall noise, traffic noise, noise from installations or apparatus in any way installed in the building, airborne noise or sounds from adjacent dwellings and from rooms and spaces used for common services.<br>For the purpose of full compliance with the above provisions, reference should be made to the work and standards recommended by the Ministry of Public Works or other qualified public bodies. | **Art. 9. Noise protection**<br><br>*Performance targets*<br>• Use materials for the construction of dwellings and their installation capable of providing adequate acoustic protection to the environment with regard to footfall noise, traffic noise, noise from systems or apparatus however installed in the building, airborne noise or sounds from adjacent dwellings and from rooms and spaces used for common services.<br>Use windows and doors able to guarantee adequate protection and sound insulation.<br>• Use air vents, air inlets and shutter boxes[5] that are acoustically certified, using, when possible, locations that are already shielded (e.g. from balconies and parapets).<br><br>*Performance*<br>• To guarantee for indoor environments, with closed windows, an environmental noise level lower than 40dB(A) during the day period and 30 dB(A) during the night period, as indicated by the regulations in force (DPCM 1.03.1991 and ss.mm.ii). |

responsible for more than one million years of life lost due to illness, disability or premature mortality in the Western countries of WHO/Europe. Noise is therefore not only a generic source of nuisance but can have a significant influence on public health and well-being. Exposure to noise, depending on its physical characteristics (intensity, frequency composition, etc.) and timing, in addition to its direct effects on the auditory system, can give rise to a whole series of so-called extra-auditive effects, such as rest and sleep disturbances (74), interference with verbal communication and learning, psychophysiological effects, damage to mental health and cardiovascular system and performance, in addition to the commonly understood annoyance (75).

In several studies on the non-audible effects of exposure to noise, it is observed that higher noise levels induce changes in systolic and diastolic blood pressure and in heart rate (76).

In children, exposure to environmental noise has been associated with fatigue, irritability, emotional stress, increased hyperactivity, increased blood pressure, increased levels of stress hormones such as adrenaline and noradrenaline (34).

## Discussion and conclusions

In recent years, several studies, considering the regulatory guidelines in the field of construction, have highlighted the need to adapt the contents of the 1975 MD (7, 77, 78) from a prescriptive- to a performance-oriented point of view.

This proposal has sought to move in this direction taking into account mainly what is already provided for in existing legislation. The focus has been exclusively on the building, taking into account all the parameters involved in the definition of habitability.

The changes concerned most of the articles of the MD 5th July 1975, which have been updated and integrated in light of the scientific literature, the new living requirements and the technological-scientific innovation consolidated in recent years (e.g. indoor air). In the preparation of the articles, the contents of several Building Codes of other European countries have been taken into account.

Almost all items, with the exception of the size aspects of the accommodation, have been revised in terms of performance, indicating for each one objective to be achieved and performances to be fulfilled.

As far as the lighting of the accommodation was concerned, attention was focused exclusively on the performance requirements of the building and therefore on natural lighting, deliberately leaving out aspects concerning artificial lighting which, in many respects, is closely linked to the choices of the individual occupants.

As previously illustrated (Tab. 4 and 5), the updated text of the MD has been integrated with some topics of particular health relevance such as, for example, the reduction of exposure to indoor chemical pollution (referring to the WHO guideline values) and protection from non-ionising radiation.

Many of the points included in the proposed update, such as aspects of size and ventilation, are of particular importance, also in light of the needs that were overwhelmingly expressed during the recent COVID-19 pandemic.

## Riassunto

***Verso un aggiornamento del Decreto Ministeriale del 5 luglio 1975***

Negli ultimi anni la Comunità Scientifica e la sanità pubblica in generale, ha dedicato un crescente interesse nei confronti delle condizioni abitative, che sono considerate, ad oggi, uno dei principali determinanti ambientali e sociali di salute della popolazione. In particolare, la Comunità Scientifica ha individuato e studiato diversi fattori di benessere indoor (es. illuminazione, temperatura, ventilazione, qualità dell'aria, ecc.). Parte di questi fattori sono stati normati da leggi e regolamenti a vari livelli: il poter disporre di chiari e aggiornati requisiti sanitari dettati dalle normative risulta fondamentale per tutelare efficacemente la salute pubblica, soprattutto in ambiente confinato. Nel presente lavoro, si propone una revisione del MD 5 luglio 1975 italiano recante "*Modificazioni alle istruzioni ministeriali 20 giugno 1896 relativamente all'altezza minima ed ai requisiti igienico sanitari principali dei locali d'abitazione*" al fine di aggiornare la definizione degli elementi essenziali che qualificano un locale come abitabile dal punto di vista igienico-sanitario, tenendo conto delle evidenze desunte dalla letteratura tecnica e scientifica sui requisiti e dai contenuti dei Building code dei principali paesi Europei.

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