Inclusive mental well-being through environmental design

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Abstract. According to the WHO, physical factors of the built environment are considered health determinants and may affect people's mental health in terms of cognitive perceptions and physical responses, triggering anxiety, stress and depression states. The purpose of this research is to carry out a literature review of the environmental, spatial and technological conditions that may affect occupants' mental health and well-being, particularly fragile people, such as elderly and people with sensorial or cognitive impairments including autism, and that may work as positive stimuli, or hindering elements for their abilities and limitations, influencing decisively their quality of life. The result consists in a set of guidelines for the design of the built environment that, starting from people with special needs, can improve liveability conditions by favouring mental health and well-being for all.

1 Introduction

The health of individuals, defined by WHO as a state of complete physical, mental and social well-being, is affected by the environment in which they lives [1]. Since people spend almost 90% of their time in buildings, several environmental factors act as "health determinants", affecting occupants' physical and mental health. Among them, physical components of the built environment may impact on people's well-being in terms of cognitive perceptions and physical responses, triggering anxiety, stress and depression states [2]. Particularly, fragile people, such as elderly and people with sensorial or cognitive impairments including autism, are strongly affected by the built environment features, that may work as positive stimuli or influence decisively their quality of life [3]. Starting from how the built environment impacts on special needs occupants, this study aims to discuss the role of environmental design in acting on people's mental health in different living spaces, in order to detect environmental design criteria for mental well-being of special needs occupants that can be applied for improving liveability and mental well-being for all.

2 Conceptual framework

2.1 Built Environment and mental health

According to WHO, mental health is one of the three basic components of health, along with physical and social well-being. Several research has shown that the built environment may affect people's mental health and well-being, which often results in terms of anxiety, stress and depression. The Covid-19 pandemic measures exacerbated this situation, due to the considerably long lockdown/quarantine which forced people to spend more time indoors and frequently interact with their surroundings in daily lives [2]. The features of the built environment that may affect occupants' mental health and well-being could depend on: environmental conditions (IAQ, thermal conditions, lighting, acoustics, etc...), spatial conditions (dimensions, simplicity and clarity of layouts, visual support and wayfinding) and technological conditions (colours, patterns, textures and building materials). IAQ depends, in general, on the contaminants inside buildings, such as malodorous pollutants and behavioural toxins. Most research on behavioural toxicity depending on heavy metals, pesticides, and solvents has focused on neurological and cognitive impacts. For example, several studies have shown a correlation between exposure to lead in early childhood and the occurrence of cognitive deficits and behavioural disorders. Several other hazardous materials (mercury, manganese, organic solvents) produce neuropsychiatric symptoms including anxiety, depression, irritability and concentration difficulties [2-5]. Thermal conditions depend on several factors, including ventilation, radiation and humidity. Excessive exposure to sunlight, living in over- or under-ventilated rooms may affect not only the physical health but also the psychological well-being of the occupants. For example, a warmer temperature may cause fatigue and a lower temperature is often associated with depression state and anxiety [2]. Adequate lighting, both natural and artificial, ensures the needs of visual well-being and improves conditions for safety and protection from injuries and falls. Natural light is an essential element for people's well-being and health in terms of regulating body functions, particularly the nervous system. Several research has shown that individuals exposed to daylight

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for a few hours daily, suffer more sadness, anxiety and depression. Some studies have shown that the therapeutic use of artificial light, particularly cooler light, has found beneficial effects in reducing depressive states and anxiety [5-7]. Crowded and noisy places are usually associated with psychological distress and even depression [2]. Sound insulation and control of noise produced in living spaces are key factors in reducing the mental stress of people who occupy these spaces [7-9]. Spatial conditions of the built environment affect its intelligibility and this may compromise the accessibility for people with specific neurological conditions such as autism, dementia, anxiety and depression. A clear spatial layout together with the provision of landmarks and simplified wayfinding, allow everyone, and particularly people with special needs, to navigate the space independently [4]. Positive correlations were found between mental health and design of the built environment that support and encourage social interactions and physical activity. On the contrary, inadequate spatial design increases the cognitive fatigue and reduces the daily productivity [5]. Intelligibility of living and circulation spaces could be implemented through the use of visual supports (pictures, pictograms, colours, etc) and wayfinding [7] [10-11]. Another important spatial feature of the built environment that may affect occupants' mental health is the dimension of the spaces. Designing living spaces with the right proportions helps to improve the occupants' psychological well-being and consequently the liveability of these environments. Redundant spaces, such as open space or long corridors, may generate bewilderment and disorientation, instead small and cramped spaces causing anxiety and oppression [7-8]. Mental health can also be affected by specific features of the built environment, which depend on technological aspects including colours, patterns and textures of the building materials and furniture. Several studies about built environment design for well-being recommend strategies to reduce glare, increase contrast where appropriate and minimizing confusion concerning depth perception [7]. Surfaces with reflective finishes or complex geometric patterns may affect people's visual and psychological well-being. Different colours affect people's moods and behaviours and their therapeutic use often helps in treating mental stress, anxiety, insomnia, headaches and depression. For example, calming and restoring colours are used in places where the mental stress is high or in places where high attention is required [8] [9] [12]. Another relevant feature of the built environment is flexibility: designing living spaces with spatial configurations that can change or through flexible furniture, allows built environment to adapt to occupants' needs and thus include as many users as possible [10]. The proximity of living spaces to green areas, including gardens, patios and balconies, is an important factor in the built environment that affects people's physical and mental well-being. Several research studies have shown that engaging in outdoor activities not only improves physical well-being, but has been found to improve depressive states and anxiety [5] [14-15].

2.2 Built Environment and special needs occupants

The physical components of the built environment are the factors that mostly affect mental health of people with special needs, such as people with Autism Spectrum Disorders, elderly with cognitive impairments such as Dementia and Alzheimer, and individuals with different psychological conditions such as depressive states and anxiety. ASD (Autism Spectrum Disorders) is a particular neurodevelopmental condition characterized by (i) difficulty in social interaction, (ii) difficulty in verbal and nonverbal communication and (iii) restricted and repetitive behaviours, interests and activities [16]. Autistics represent an extremely heterogeneous clinical condition, so there is a marked variability in the expression of symptomatology from patient to patient in them [17]. Complexity in the interaction between the environment and people with ASD is due to altered perception of sensory stimuli of the built environment. Perceptual distortion, in fact, can occur both in the reception of sensory stimuli and in the interpretation of them and can affect one or more stimuli simultaneously. [10]. This considerable variability leads to a multiplicity of manifestations such as anxiety, stress, disorientation, aggressive or repetitive behaviours, distractibility, escape reactions, etc. Dementia is an umbrella term for several progressive disorders affecting memory, other cognitive abilities including orientation, comprehension and the ability to perform everyday activities. Although age is the strongest known risk factor for dementia, it is not a normal part of ageing [18]. Alzheimer disease is the most common type of dementia. Its symptomatology is heterogeneous and complex and the main manifestations are agitation, disinhibition, verbal and behavioural aggressiveness, anxiety and depression [13] [19]. Since elderly people, in particular those suffering from dementia, spend a large part of their time in living spaces, it is necessary to identify therapeutic design criteria for a safe and supportive built environment in order to preserve and optimize their independence [14]. Depression is one of the most common mental disorders and is estimated to affect over 300 million people worldwide [20]. This disease has been linked to both social and physical aspects of the built environment, including social factors, such as isolation and poverty in the neighbourhood, to housing quality, crowding and urban design of streets and green spaces [21]. Several research has shown that the onset of depressive states may depend on physical built environment features that include, for example, noise, indoor air quality (inadequate temperature and exposure to moisture and mould), overcrowding, and lighting [15].

3 Research Method

3.1 Aims of the literature review

The purpose of this study is to overview scientific literature about the physical factors of the built environment that impact on people's mental health and

well-being, particularly on special needs occupants i.e. autistic, elderly with dementia and people with several cognitive disease like depression and anxiety. Specifically, the selection of the scientific literature and its critical analysis is aimed at identifying main approaches of therapeutic environmental design in different application contexts and select environmental design criteria for living spaces which, starting from special needs occupants' satisfaction, can guarantee well-being for all. The study is based on three steps: (i) literature searching, (ii) studies selection, according to eligibility criteria (reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart) and (iii) data synthetization.

3.2 Literature Searching

The search strategy consisted in a set of keywords (Environmental design, Architecture, Spatial design, Built environment, Urban environment, Neighbourhood, Design guide, Design criteria, Sensory design) related to the main search topics (Built Environment, Spatial Design, Mental Health, Autism, Dementia, Alzheimer, Depression) using the following databases: PubMed, Scopus, Web of Science and Google Schoolar. Monographies and recent grey literature were also included, according to the eligibility criteria, as following described.

3.3 Inclusion and Exclusion Criteria

Inclusion and Exclusion criteria have been defined according to the research question. First, literature review articles were preferred, in order to have a broader overview of the existing scientific production on the topics. Papers and studies whose outcome were environmental design criteria, guidelines or design indications were selected. The outcomes are referred to the special needs occupants' without any limitation in age and severity of the neurological conditions. Studies from other fields whose outcomes are not related to spatial design (for example, medical and clinical studies) were excluded from the literature review.

3.4 Studies selection

The studies were screened following two main steps: checking through title and abstracts and reading through selected papers full-text. The screening process is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. In total 56 studies were identified (n=47 through databases searching, n=9 through other sources), and, excluding the possibility of duplicates, they were screened through title and abstract checking. Full-text studies assessed for eligibility were 33, but at the end of the second stage a total of 19 met the inclusion criteria.

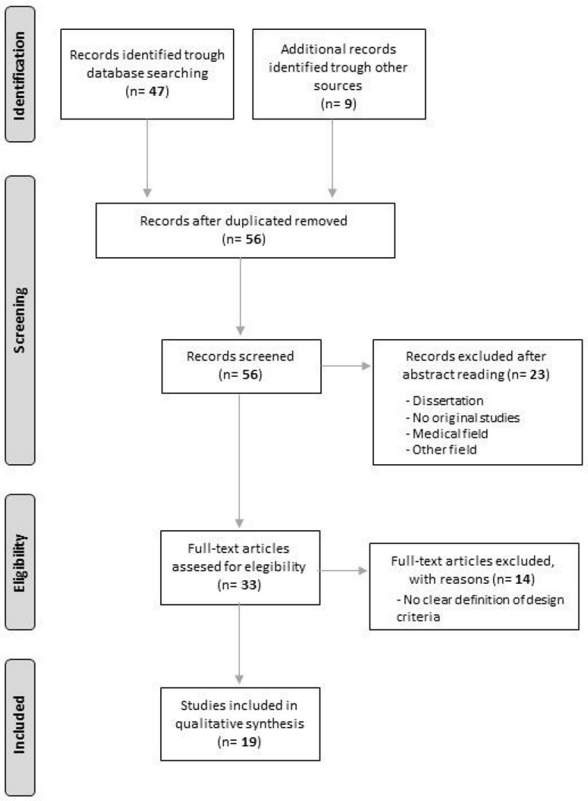

Fig. 1. The studies selection process is reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart model [28].

3.5 Data Extraction and Summary

Relevant information has been extracted and summarized using a data grid containing: (i) main study characteristics (authors, publication year, study design), (ii) health conditions (mental health, autism, dementia/Alzheimer, depression), (iii) living spaces (residential, healthcare, learning spaces, working spaces, outdoor environment) and (iv) the study outcomes. (Tab.1).

Tab. 1. Data of included studies.

Author(s) (year)	Study design	Health conditions	Living spaces type	Study outcome
Xiao, J., Zhao, J., Luo, et al (2022) [2]	Survey	Mental health	Residential	Identification of physical factors in the built environment that may affect metal health (particularly during the covid-19 pandemic) and related design recommendations.
Evans, G.W. (2003) [4]	Research	Mental health Alzheimer	Residential	Direct correlations with mental health of the built environment: - Housing - Alzheimer's facilities - Crowding - Noise - Indoor Air Quality - Lighting
Riva, A., Rebecchi, A., et al (2022) [5]	Scoping review	Mental health Depression Anxiety Stress	Residential	The impact of the built environment in the residential setting-housing conditions—on mental health: - Indoor Environmental Quality (IAQ, thermal comfort, lighting comfort, acustic comfort) - Housing conditions (house type, floor level, quality, green spaces)
Osibona, O., Solomon, B.D., Fecht, D. (2021) [6]	Systematic review	Physical Health Mental Health Depression Anxiety	Residential	Identification of the effects of lighting (natural and artificial) on physical health and mental health (particularly anxiety and depression) with special reference to its therapeutic use
Day, K., Carreon, D., Stump C. (2000) [7]	Empirical research	Dementia	Healthcare buildings	Identification of features of the built environment that affect well-being including: - levels of sensory stimulation - levels of lighting Identification of relevant spatial features including : - orientation (spatial organization and wayfinding) - outdoor green spaces
Black, M. H., McGarry, S., Churchill, L. et al (2022) [8]	Scoping review	Autism	Residential Learning spaces	Aspects of the BE were described under the following headings: design and construction, light, sound, aesthetics, air quality and temperature
Pragati, S., Shanthi Priya et al. (2022) [9]	Literature review	Mental health	Residential Healtcare buildings	Identification of features of the built environment that affect mental health and are found to have positive effects on the psychological conditions of individuals in healing spaces
Tola, G., Talu, V., Congiu, T. et al. (2021) [10]	Scoping review	Autism	Residential Healthcare buildings Learning spaces Working spaces Outdoor areas	Analysis of features of the built environment that affect the psychological well-being of individuals with ASD. Return of design guidelines for autism-friendly environments that refer to 3 spatial criteria : - sensory quality - intelligibility - orientation
Day, C., Calkins, M. P. (2002) [11]	Review	Dementia	Residential Healtcare buildings	Identification of design criteria for more supportive living environments (residential and care) for the elderly, and in particular elderly with dementia.
Schweitzer, M., Gilpin, L., Frampton, S. (2004) [12]	Review	Mental health Stress Anxiety	Healthcare buildings	Identification of physical factors of built environment that positively affect psychological well-being during recovery. Of these features (sound, lighting, temperature, spatial understanding, colors), were identified design guideline for therapeutic use
Soril, L. J. J., Leggett, L. E. et al. (2014) [13]	Systematic review	Dementia	Healthcare buildings	Identification of aspects of the built environment that may have positive affects on symptom control of elderly people with dementia in healthcare buildings
Sturge, J., Nordin, S. et al (2021) [14]	Scoping review	Dementia	Residential Outdoor areas	Identification of strategies for improving the mental and psychological well-being of the elderly with dementia through interaction with the built environment: - interventions to connect and interact with society - interventions to improve interaction with the built environment and public spaces
Rautio, N., Filatova, S. et al (2017) [15]	Systematic review	Depression	Outdoor areas	Identification of the features of the built environment that have effects on people's mental health, particularly on depression: urban-scale design strategies were identified in this regard
Shin, J., Dennis, S. Jr. et al (2021) [22]	Critical review	Mental health	Residential	- The physical environment and its impact on mental health and well-being - Six categories of mental health outcomes: affect, mood, vitality, executive functioning, mental stress and mental well-being
Strong, D.T.G (2012) [23]	Paper	Mental Health	Healthcare buildings	Therapeutic use of dayligh in healthcare buildings, in particular to manage: - depression - stress and agitation
Zhang, Y. et al (2012) [24]	Paper	Mental health	Healthcare buildings	Identification of guidelines for environments that support mental health in recovery through design principles related to relevant physical characteristics of the built environment
Mahmood, F. J., Tayib, A. Y. (2020) [25]	Case Study	Mental health	Healthcare buildings	The study identifies the most relevant features of the built environment to which, using a survey, patients assign a rating in order to identify those that most impact mental health
Leung, M. et al (2020) [26]	Research	Dementia	Healthcare buildings	Identification of physical and social features of the built environment that may impact mental health. Return of design guidelines for more supportive environment
Gan, D., Chaudhury, H. et al (2022) [27]	Scoping review	Dementia	Outdoor areas	Identification of the characteristics of urban spaces that may impact the elderly with dementia in order to identify design solutions related especially to outdoor open spaces

4 Results

4.1 Living spaces

The analysis of the scientific literature shows a complex and heterogeneous identification of the living spaces involved in the research reviewed. Most of the selected articles focus the features of the built environment in relation to mental health and well-being and identified design criteria both in residential [2,4,5,6,8,9,10,11,14,22] and healthcare spaces [7,9,10,11,12,13,23,24,25,26]. Two scoping reviews analyzed the features of learning spaces [8,10] that significantly affect people with Autism Spectrum Disorders in order to identify design criteria. One paper investigated the characteristics of work environments that can affect workers' mental health [10] and three review analyzed outdoor environmental characteristics [10,15,27] in relation to mental well-being of autistics, elderly with dementia and people with other psychological conditions as depression and anxiety.

4.2 Built Environment design criteria: a starting point

Data sourced from the literature review have been structured in a list of criteria for the design of supportive indoor and outdoor environments for people with special needs. Criteria can be also applied in therapeutic environments for well-being of all occupants. The design criteria can be divided in three groups in relation to: (i) environmental conditions, (ii) functional/spatial conditions and (iii) technological conditions. (i) Environmental conditions of built environment (lighting, acoustic, IAQ) generate sensory input whose perception is generally altered for people with cognitive impairments (Tab. 2). *Natural lighting* is preferred, in relation to its positive effect on mental health and well-being, but is desirable that it should be indirect, from above or appropriately screened to reduce glare and distractibility. If *artificial lighting* is used, it is preferable LED because fluorescent lights generate flicker and background hum. It is preferable that it be nonpoint source, avoiding eye level positioning, and adjustable in intensity (for example, using dimmer) and colour. With regard to *acoustics*, it is preferred to use sound-absorbing building materials, where necessary to use carpets and rugs to attenuate footstep noise and to avoid rooms with high ceilings that generate glare. It is advisable to install high-efficiency air conditioning systems that do not produce background noise. To ensure adequate *IAQ* (thermal conditions, humidity, reduction of toxins and pollutants), it is advisable to ensure good natural ventilation of living spaces.

Tab. 2. Design criteria related to environmental conditions.

ENVIRONMENTAL CONDITIONS		DESIGN CRITERIA	REFERENCES

LIGHTING	NATURAL	• Prefer *natural lighting*
		• Prefer *indirect natural lighting*:
		  ○ Prefer natural lighting from above (e.g., through skylights)
		  ○ Provide *systems to shield* direct natural light and avoid glare
		  ○ Provide *systems to screen* windows to reduce outward visibility and avoid distractions
		• Prefer lighting of adjustable intensity:
		  ○ Provide *systems to regulate luminous flux*
			[2] [3] [4] [5] [6] [7] [8] [9] [10] [12] [22] [23] [25] [26] [27]

	ARTIFICIAL	• Prefer *LED lighting* instead of fluorescent lighting, which causes flickering and background humming • Prefer *lighting from above* • Prefer *diffuse lighting systems* • Prefer *intensity-adjustable lighting* (e.g., through use of dimmers) • Prefer *colour-adjustable lighting*	
ACUSTIC		• Prefer *sound-absorbing flooring* (e.g., softwoods or cork panels) • Provide for the *use of carpets or rugs* that help absorb footfall noise • Provide for *the installation of sound-absorbing panels* along the walls most exposed to noise sources • Avoid *high ceilings* that can cause reverberation • Provide, where possible, for the *installation of garden roofs to attenuate rain noise* • Install *efficient air conditioning systems* that produce less background noise	[2] [3] [4] [5] [7] [8] [9] [10] [12] [14] [24] [25] [26] [27]
IAQ		• Ensure *good natural ventilation* • Ensure *indoor temperature control* both naturally through ventilation and mechanically through the installation of high-efficiency air conditioning systems	[2] [3] [4] [5] [8] [9] [10] [12] [15] [24] [25] [26]

(ii) Functional and spatial conditions (layout, function of spaces and orientation) may affect the perception of the living spaces and compromise their intelligibility (Tab. 3). Layout should be clear, made by a *simple spatial organization*: itineraries easy to read and arranging the activities/functions of the rooms in a sequential distribution, in order to promote predictability and control of the space. Multifunctional spaces may affect people negatively. *Proportions* of the living spaces should be observed: spaces with very high ceilings that may generate glare and disorientation and, at the same time, small or with too low ceilings spaces, may cause oppression and anxiety. Long hallways are also to be avoided. In order to achieve a supportive built environment for people with cognitive diversity, it is also advisable endow the living spaces with specific functions, designed following accurate principles. In *circulation spaces* should be avoided frequent different floor levels in order to guarantee safety and facilitate orientation. It is advisable ensure a good visual relation between spaces, in order to maximize the visual field and improve wayfinding. This should be obtained avoiding blind corners, which can hide unexpected situations generating anxiety and restlessness, and preferring curved walls. The built environment, particularly public spaces such as learning and working spaces or cultural spaces, may often be overloaded with sensory stimuli. In order to reduce cognitive overload, for example in autistics or elderly with dementia, *quiet spaces* designed with low or no sensory stimulation (for example neutral colors and small size) should be provided. For a supportive built environment for people with special needs, it is advisable to provide spaces with sensory areas (rooms or gardens) that can have a therapeutic effect on people with cognitive diversity, for example designing *sensory room* which can offer different stimulations (visual, auditory, and tactile). Simple and defined layouts may be supported by good *wayfinding* by using, for example, circulation scheme based on visual supports and color coding for predefined routes or for highlighting spaces and elements (e.g., doors or landmarks).

Tab. 3. Design criteria related to functional/spatial conditions.

FUNCTIONAL/SPATIAL CONDITIONS		DESIGN CRITERIA	REFERENCES
LAYOUT	SPATIAL ORGANIZATION	• Provide *simple spatial organization* • Prefer *itineraries easy to read* • Arrange *activities through a sequential arrangement*, so as to foster a routine and thus greater predictability • Avoid *multifunctional spaces* • Locate activities to be performed by *sensory zoning*, that is, grouping activities according to the intensity of sensory stimulation	[4] [5] [7] [8] [10] [11] [12]

	DIMENSION AND VOLUMES	• Design spaces with the *right proportions*:
		  ○ avoid *small spaces with too low ceilings* that can generate oppression
		  ○ avoid *oversized spaces with too high ceilings* that can generate bewilderment and glare
		• Avoid *long corridors*
			[4] [5] [7] [8] [10] [11] [12]

FUNCTION OF SPACES	CIRCULATION SPACES	• Ensure a *good visual relationship between spaces*: ○ avoid *blind corners*, which can hide unexpected situations generating anxiety and restlessness, and prefer *curved walls and rounded corners* • Avoid *long corridors*, which can generate anxiety • Avoid *frequent different floor levels*, to facilitate orientation and improve safety when navigating spaces • Provide a *possibility of choice* • Provide a *hierarchy in spaces*	[4] [5] [7] [8] [10] [11] [12]

	QUIET SPACES	• Provide *quiet spaces* to retreat and reduce cognitive overload
		  ○ spaces with *low or no sensory stimulation*
		  ○ *small spaces*
		  ○ *neutral colors* with few details
		  ○ *permanence of eye contact* with the surroundings
			[7] [8] [10] [11]

	SENSORY SPACES	• Provide *sensory rooms*, which can provide different sensory stimulation (visual, auditory, and tactile)	[7] [8] [10] [11]
ORIENTATION AND WAYFINDING		• Use *circulation scheme based on visual spports* • Make *predefined routes using*, for example, color coding • Use color to *recognize spaces and elements* (e.g., doors and entrances)	[4] [5] [7] [8] [10] [11] [12]

(iii) According to the literature, technological conditions (colors, patterns and textures of the building materials and furniture) may affect significantly people's mental health and well-being (Tab. 4). Several research has shown that *color* may affect people's psychological and mood conditions: the therapeutic use of colored lights is recommended to relieve depressive states and anxiety. For living spaces it is advisable to choose neutral or pastel colors and avoid strong chromatic contrasts and bright colors where possible. Multiple color palettes and complex geometric patterns should be avoided. Even the choice of the surface finishes of the *materials* must be accurate: different textures are to be avoided, where possible, and a balance between rough and soft textures must be provided to accomodate all needs; mirrored and reflective surfaces can generate glare; natural materials have calming effects such as wood, cotton and porcelain. To ensure long-lasting use, it is advisable to choose strong materials that are easy to maintain and clean. Even the choice of *furniture* can be well defined; flexible furniture can be adapted to different user needs.

Tab. 4. Design criteria related to technological conditions.

TECHNOLOGICAL CONDITIONS		DESIGN CRITERIA	REFERENCES

BUILDING MATERIALS	COLOURS AND PATTERNS	• Prefer *soft and/or pastel colors and natural colors* (white, ivory, pale pink, etc.)
		• Limit *excessive color contrast* wherever possible
		• Avoid *bright colors*
		• Use *color contrast* in color coding *to facilitate orientation*
		• Avoid the use of *complex color palettes*:
		  ○ light blue is recommended in classrooms
		  ○ light green is recommended in entryways for its calming effect
		• Avoid *complex patterns*
			[3] [7] [8] [9] [10] [11] [12] [25]

	MATERIAL AND TEXTURES	• Restrict, where possible, the *excessive use of materials with different textures* • Prefer *non-reflective and glossy materials* to avoid glare • Prefer *materials that are easy to clean* • Use *materials that do not emit chemicals* • Prefer *natural materials* having calming effects, such as cork, cotton, porcelain and wood • Prefer *non-slip flooring* (such as vinyl) • Prefer *strong materials* of surface to improve safety • Prefer *soft textures*, especially for noise reduction • Prefer *a balance of rough and soft textures*, to accommodate all needs	
FURNITURE		• Possibility of using *furniture as space compartmentalization* • Prefer *flexible furniture* that can adapt to different user needs	[7] [8] [9] [10] [11]

5 Discussion

5.1 Conclusions

The study is aimed at discussing the physical factors of the built environment that may impact on mental health. Starting from the design criteria for supportive environment for people with special needs, i.e. autism, a set of design criteria for the built environment that could improve liveability of living spaces for all has been identified.

5.2 Further Recommendations

This study revealed a large and homogeneous scientific literature about design criteria for autism-friendly living spaces. In contrast, the existing scientific literature referring to other neurological conditions, such as dementia and depression, is very heterogeneous and fragmented. In addition, based on the selected literature, it was found that there is a lack of design suggestions for supportive built environment for people with depression state and anxiety. Only design recommendations at the urban scale and for outdoor spaces have been identified. Most of the reviewed studies focus built environment features related to specific living spaces: residential, learning spaces and healthcare buildings. Public spaces, such as workplaces, sites of cultural interest (museums, archaeological sites, churches, etc), large infrastructures (airports, railway stations) and recreational spaces (cinemas, theatres, gyms, etc) result less investigates.

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