Dementia-Sensitive Environmental Design of Living Units in German Nursing Homes: First Results of the German Environmental Audit Tool (G-EAT)

Demenzsensibilität der baulichen Umgebung langzeitstationärer Pflegeeinrichtungen in Deutschland: Erste Ergebnisse des German Environmental Audit Tool (G-EAT)

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ABSTRACT

Background The built environment is a key component of dementia-specific care. Little is known about the characteristics of dementia-sensitive environmental elements in living units of nursing homes in Germany. The German Environmental Audit Tool (G-EAT) is a systematic assessment tool for describing these elements in detail. Aim of the study: To describe the extent of dementia-sensitive design principles and environmental elements in a regionally limited sample of living units in Germany.
Methods The built environment was assessed using G-EAT and analysed quantitatively and descriptively. Definitions of living units were developed based on site visits and analysed using qualitative content analysis.
Results The 42 participating living units were heterogeneous in terms of space and composition. Dementia-sensitive design principles varied greatly in their implementation in the built environment; on average, 87.7 % of the environmental elements were oriented towards a familiar environment. In contrast, visual accessibility was much less frequently enabled by the built environment (mean 37.3 %).
Conclusions The characteristics of various dementia-sensitive environmental elements need to be further investigated against the background of the nursing home care concept and the homogeneity of the resident group to enable the initiation of tailored environmental adaptation that can be implemented by interdisciplinary teams in nursing homes. This also requires a follow-up study with a larger sample of living units to identify the factors that promote and inhibit the development of a dementia-sensitive environment.

ZUSAMMENFASSUNG

Hintergrund Die bauliche Umgebung stellt eine Schlüsselkomponente demenzspezifischer Versorgung dar. Über die Ausprägung demenzsensibler Umgebungselemente in Wohnbereichen deutscher langzeitstationärer Pflegeeinrichtungen ist bislang wenig bekannt. Mit dem German Environmental Audit Tool (G-EAT) steht ein systematisches Assessmentinstrument zur Verfügung, mit dem diese Elemente tiefergehend

erfasst werden können. Ziel der Arbeit: Beschreibung der Ausprägung demenzsensibler Gestaltungsprinzipien und Umgebungselemente in einer regional begrenzten Stichprobe in Wohnbereichen deutscher Pflegeeinrichtungendeutscher Wohnbereiche.

Methoden Die bauliche Umgebung wurde mit dem G-EAT erfasst und quantitativ-deskriptiv ausgewertet. Auf der Basis von Einrichtungsbegehungen wurden Definitionen der Wohnbereiche erstellt und mittels qualitativer Inhaltsanalyse ausgewertet.

Ergebnisse Die 42 Wohnbereiche zeigen heterogene Charakteristika hinsichtlich der Größe und der Zusammensetzung der darin enthaltenen Räume. Demenzsensible Gestaltungsprinzipien variieren in der baulichen Umsetzung stark: Umgebungselemente, die sich an einem familiären Umfeld orientieren, sind durchschnittlich zu 87,7 % vorhanden. Visuelle Zugangsmöglichkeiten werden hingegen deutlich seltener durch die bauliche Umgebung ermöglicht (MW 37,3 %).

Schlussfolgerungen Die Ausprägung verschiedener demenzsensibler Umgebungselemente muss vor dem Hintergrund des Pflegekonzepts der Einrichtungen und der Homogenität der Bewohner*innengruppe weiter untersucht werden, um passgenaue Umgebungsanpassungen initiieren zu können, die von den interdisziplinären Teams der Pflegeeinrichtungen umgesetzt werden können. Dies erfordert auch eine weiterführende Betrachtung anhand einer größeren Stichprobe von Wohnbereichen, um fördernde und hemmende Faktoren für die Umsetzung einer demenzsensiblen Umgebungsgestaltung zu identifizieren.

Introduction

The built environment is a key component of dementia-specific care [1]. The term 'built environment' refers to all human-made, planned and physical environments. This applies to both indoor and outdoor areas where the existing natural environment has been altered [2]. In home-based care, an environment adapted to a person's needs can provide safety and help the person stay at home for as long as possible [3]. However, even for people with dementia living in nursing homes, an environment adapted to their needs and preferences can help them remain independent, and thus contribute to a positive quality of life [4].

In healthcare research, the built environment is an important contextual factor, for example, when implementing interventions in a sustainable way [5] or for understanding the mechanisms underlying the effectiveness of dementia-specific living concepts [6]. The effects of a dementia-sensitive environment on the successful implementation of interventions have not yet been systematically examined in German nursing home research. This is due to the complexity of the construct and the lack of instruments tested in Germany. As a result, the characteristics of the living concept, the group size in living units, and the number of beds in nursing homes have previously been assessed to capture the elements of the built environment [7].

The impact of environmental elements on dementia-specific care has been internationally investigated for decades. This work resulted in the development of guidelines for dementia-sensitive design of healthcare facilities [8, 9] and assessment tools to evaluate the implementation of these design principles [10].

Based on this knowledge, an existing tool (Environmental Audit Tool - High Care (EAT-HC)) was adapted at the German Centre for Neurodegenerative Diseases, Site Witten for Germany. As part of a multistage adaptation process, experts in research and dementia care practice were involved in adapting the tool culturally sensitively for use in German nursing homes [11].

The original tool was developed by an inter-professional team and has been shown to have adequate validity and reliability when tested psychometrically [12, 13]. The dimensions of the tool include ten *dementia-sensitive key design principles*[14], based on the theory that the built environment can support a person's declining ability to perform activities of daily living [15]. These key design principles are based on questions regarding evidence-based *dementia-sensitive environmental elements* related to different rooms within a nursing home living unit.

Following adaptation of the EAT-HC to the German Environmental Audit Tool (G-EAT), the instrument was tested for practicability, interrater reliability, and internal consistency [16]. In this article, we present the initial results of the development of a dementia-sensitive design for nursing homes and discuss possible ways in which it can be applied. In doing so, we addressed the following research questions:

To what extent are living units in German nursing homes designed according to dementia-sensitive design principles?

- Which spaces does the built environment of those living units include?
- Which *dementia-sensitive key design principles* are fulfilled or not fulfilled?
- Which *dementia-sensitive environmental elements* are present in the most or least living units?

Methodology

Study design

Qualitative and quantitative data were collected as part of a descriptive cross-sectional study to test the feasibility and reliability of G-EAT. These data were used for secondary data analysis in this study.

Recruitment and sampling

Data were collected from a convenience sample of nursing homes in North Rhine-Westphalia. The reason for the regional limitation was that the underlying conditions were regulated at the federal state level *(e. g. HeimMindBauV NRW, Wohn- und Teilhabegesetz NRW)*, which offers different possibilities for the design and scale

of the built environment. To recruit participants for the study, 170 nursing homes within a 20 km radius of the research institute were contacted in writing and then by telephone. To avoid clustering effects caused by several living units in the same facility, one living unit was selected from each participating nursing home.

Measurements

The built environment of the living units was assessed using the G-EAT. In the version used here for non-secured living units, the instrument consists of 74 items [11], of which 72 items *(environmental elements)* can be assigned to nine dimensions *(key design principles): Create a human scale; Reduce risks unobtrusively; Allow people to see and be seen;* Manage (positive/negative) levels of stimulation*; Support movement and engagement; Create a familiar place; Links to the community.* The dimension *"environment as part of the care concept"* contains two additional questions, which are relevant for the subsequent practice-oriented interpretation of the results. The psychometric quality of the original instrument had already been tested and was determined for the adapted German language instrument as part of the test study. Inter-rater reliability, measured by inter-rater correlation coefficients, varied between 0.662 and 0.869 at the subscale level. At the item level, 42 % of the items showed at least substantial agreement between two raters (Cohen's Kappa ≥ 0.60) [16]. The G-EAT mainly consists of dichotomous items, with 14 items offering categorical response options. The structural characteristics of the living units were collected using a context questionnaire that was applied in a previous study [17]. Definitions of the living units were developed through site visits with staff and included the following criteria: *A) identification of rooms belonging to the living unit, B) identification of shared spaces across living units, C) boundaries of the living unit.*

Data collection

Data collection took place between August and December 2019 and was conducted with at least one staff member from the nursing home. First, a short training session on the key design principles of dementia-sensitive design was held for relevant staff members. This was followed by a tour of the facility and a joint definition of a living unit. This was used to determine where residents could spend time, regardless of whether they overlapped with the planned space or had chosen alternative locations for certain activities (e. g. using corridors as a place to spend time). The boundaries of the living unit refer to both those within the facility and the outdoor areas belonging to the living unit, such as a shared garden. One member of the research team then completed the G-EAT. To answer the questions of the G-EAT, all shared spaces in the living unit were explored. For ethical reasons, the answers to questions about the residents' private rooms were based on information provided by the staff, as the researchers did not enter private rooms without being invited to do so by the residents.

Data analysis

Quantitative data analysis *(G-EAT/context questionnaire)* was performed descriptively using SPSS 25 [18]. Because the reference values of the *key design principles* vary from dimension to dimension, the percentage mean was calculated at this level, and the weighted mean was used for the overall result of the G-EAT. A comparison of the characteristics of the living units was carried out using qualitative content analysis according to Mayring in MAXQDA 2022 [19, 20].

Results

Contextual characteristics of included living units

This study included 42 living units in nursing homes in North Rhine-Westphalia. The contextual characteristics are presented in ▶ **Tab. 1**. Most were run by nonprofit organisations (73.8 %) and located in cities (81.0 %). Residents with and without dementia lived together in most living units (integrative living concept) (66.7 %). Nursing homes were established in roughly equal proportions before (47.6 %) and after (52.4 %) the introduction of the German long-term care insurance system and the associated requirements for organisational change. Group sizes varied between 9 and 40 residents.

Included spaces of living units

Most living units provided only one multifunctional room for lunch or as a living room (61.9 %). In the four units, the staff defined corridors and intermediate spaces as the main places where residents spend time. Thirteen living units had their own outdoor spaces (six sheltered gardens and seven balconies). The cafeteria (61.9 %), party rooms (35.7 %), and various group rooms were the primary spaces used across all living units in the nursing home. The latter are either multifunctional or have specific functions (e. g. corner shops, football rooms, or bowling alleys). Of the living units, 71.4 % are located on one floor, eight are on the ground floor, and therefore have barrier-free access to outside spaces without the need for a lift.

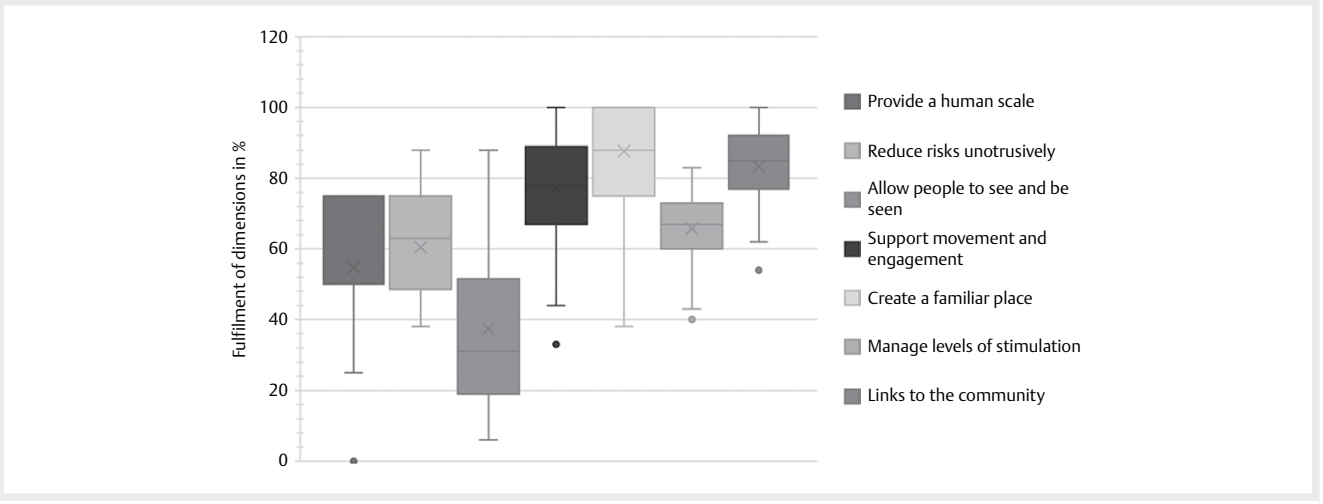
▶ **Tab. 1** Contextual characteristics of the living units.

Characteristics (*N* = 42)	**Sample**
	% (n)
Sponsorship	
non-profit	73.8 % (31)
profit	26.2 % (11)
Size of the municipality in which the nursing home is located	
20.000–100.000 inhabitants	19.0 % (8)
100.000–1,000.000 inhabitants	81,0 % (34)
Living concept	
integrative	66.7 % (28)
segregative	34.3 % (14)
Opening year of the facility	
before 1994	47.6 % (20)
before 1994	52.4 % (22)
Group size[b]	
≤ 10 residents	2.4 % (1)
11–16 residents	40.5 % (17)
17–29 residents	45.2 % (19)
≥ 30 residents	11.9 % (5)

[a] Group classification based on the introduction of long-term care insurance (SGB XI); year of opening, as the construction period may extend over several years; [b]classification using G-EAT

▶ **Tab. 2** Overview of dementia sensitivity of the living environment at the dimension level *(Key design principles).*

Key Design Principle (Dimension)	N_{Items}	Max. Score	MW in % (score)	Range in % (score)	Standard deviation
Provide a human scale	2	4	54.8 % (2.2)	0–75 % (0–3)	± 0.79
Reduce risks unobtrusively	13	16	60.4 % (9.6)	38–88 % (6–14)	± 2.23
Allow people to see and be seen	10	16	37.3 % (6.0)	6–88 % (1–14)	± 3.39
Manage levels of stimulation	25	30	65.8 % (19.7)	40–83 % (12–25)	± 3.2
Support movement and engagement	9	9	77.4 % (7.0)	33–100 % (3–9)	± 1.31
Create a familiar place	4	8	87.7 % (7.0)	38–100 % (3–8)	± 1.09
Links to the community	9	13	83.4 % (10.8)	54–100 % (7–13)	± 1.65



▶ **Fig. 1** Box chart of the dementia sensitivity of living units at the level of the dimensions (key design principles).

Specification of dementia-sensitive key design principles

With regard to the dementia-sensitive key design principles, it can be seen that the dimension *"Create a familiar place"* is the most pronounced at 87.7 % (range 38–100 %; SD ± 1.65) (see ▶ **Tab. 2**). The dimension *"Allow people to see and be seen"* has the lowest level of expression (MW 37.3 %, range 6–88 %; SD 3.39). ▶ **Fig. 1** shows the different characteristics of the dementia-sensitive key design principles.

Specification of dementia-specific environmental elements

Individual items within a key design principle relate to various elements of a living unit. Therefore, an analysis of the questions at the item level is relevant to the interpretation of the results (see ▶ **Tab. 3** and **4**). The three environmental elements that are fulfilled by most of the living units are *"Bed/ensuite transfer is easy"* (100.0 %), *"Inside, ramps are wheelchair accessible*" (97.6 %) and *"Inside, floor surfaces are safe"* (92.9 %). The fewest living units show the dementia-sensitive environmental elements *"Doors are silent when closing"* (2.4 %), *"Inside, glare is avoided"* (7.1 %) and *"Toilet pan can be seen from bed"* (14.3 %).

The least pronounced key design principle, *"Allow people to see and be seen"*, shows that in more than 50 % of the living units, less than 25 % of the residents can use direct visual axes between different rooms. The environmental elements covered by the *"Create a familiar place"* dimension show that unfamiliar furniture is used in only one case. To answer these questions, furniture and objects that do not appear familiar but must be present for functional and/or occupational safety reasons (e. g. height-adjustable care bed) were defined in advance.

Discussion

We illustrate that living units are heterogeneous in terms of equipment and spatial arrangements. Environmental elements aimed at creating familiarity are present in almost all living units, while the possibility of visual axes between rooms and the avoidance of negative acoustic and visual stimuli is limited.

▶ **Tab. 3** Fulfilment of dementia-sensitive environmental design elements in living units (G-EAT dichotomous items).

Dementia-sensitive environmental elements	Percentage of living units that fulfil the element (n) [a]
Provide a human scale	
Common areas are comfortable in scale	85.7 % (36)
Reduce risks unobtrusively	
Outside access is barrier-free	71.4 % (30)
Outside, floor surfaces are safe	76.2 % (32)
Outside, path surfaces are even	50.0 % (21)
Outside, paths are obstacle-free	90.5 % (38)
Outside, paths have appropriate width (1.8 m)	35.7 % (15)
Outside, ramps are wheelchair accessible	78.6 % (33)
Inside, floor surfaces are safe	92.9 % (39)
Inside, contrast between floor surfaces is avoided	71.4 % (30)
Inside, ramps are wheelchair accessible	97.6 % (41)
Bed/ensuite transfer is easy	100.0 % (42)
Allow people to see and be seen	
Garden/outside area exit is seen from lounge/dining room	35.7 % (15)
Dining room is seen from lounge room	81.0 % (34)
Toilet is seen from lounge room	31.0 % (13)
Toilet is seen from dining room	23.8 % (10)
Lounge room is seen by staff	90.5 % (38)
Dining room is seen by staff	85.7 % (36)
Outside, resident area is seen by staff	38.1 % (16)
Manage levels of stimulation[a]	
Doors to dangerous areas are invisible	66.7 % (28)
Wardrobes are non-cluttered	21.4 % (9)
Public address/paging/call system is unobtrusive	81.0 % (34)
Doors are silent when closing	2.4 % (1)
Visual clutter is absent	26.2 % (11)
Inside, glare is avoided	7.1 % (3)
Rooms are easily identifiable	90.5 % (38)
Dining room is clearly recognisable	83.3 % (35)
Lounge room is clearly recognisable	71.4 % (30)
Corridors are clearly identifiable	57.1 % (24)
Bedrooms are individually identified	73.8 % (31)
Shared bathrooms/toilets are clearly identified	50.0 % (21)
Toilet pan can be seen from bed	14.3 % (6)
Toilet seats contrast with background	47.6 % (20)
Inside, contrast aids visibility of surfaces/objects	88.1 % (37)
Inside, olfactory cues are used	50.0 % (21)
Inside, tactile cues are used	90.5 % (38)
Inside, auditory cues are used	31.0 % (13)
Outside, contrast aids visibility of surfaces/objects	92.9 % (39)
Outside, materials/finishes are varied	95.2 % (40)
Outside, olfactory cues are used	97.6 % (41)
Outside, auditory cues are used	66.7 % (28)
Outside view from dining/lounge is attractive	81.0 % (34)
Support movement and engagement	
In-/outside path clearly returns residents to starting point	23.8 % (10)
Outside, path passes participation opportunities	76.2 % (32)
Outside, activity choices are available	64.3 % (27)
Outside, seating is available	90.5 % (38)
Outside, sunny and shady areas are available	85.7 % (36)
Outside, passive activities are available	97.6 % (41)
Outside, verandas and shaded seating are available	100.0 % (42)
Inside, path passes participation opportunities	78.6 % (33)
Inside, path passes conversation/rest areas	78.6 % (33)
Links to the community	
Dining room allows for dining alone	81.0 % (34)
Lounge room includes private conversation areas	66.7 % (28)
Outside, private conversation areas are available	100.0 % (42)
Community interaction areas are accessible	97.6 % (41)
Family/dining area is available in facility	100.0 % (42)
Visitor break area is available	88.1 % (37)
[a]N = 42 living units	

General conditions for the realisation of dementia-sensitive environmental design

A comparison of the degree of fulfilment of the individual questions with existing regulations that influence the construction of nursing homes in Germany shows that some environmental elements that are fulfilled by the majority of living units are also laid down in legally binding regulations such as DIN 18040–1 *"Barrier-free construction"* [21]. Another condition to bear in mind is that missing visual axes can only be corrected with great effort and the involvement of architects, whereas environmental elements that promote positive acoustic, olfactory, or tactile stimuli can be implemented by a multi-professional team in the facility as part of the design of the living environment.

Challenges in capturing the dementia sensitivity of the built environment

The challenge of capturing the complexity of the built environment using a systematic assessment tool was also evident in this preliminary exploration. On the one hand, the question arises as to whether and, if so, which references can be used as a basis for the questions to be assessed categorically, for example, when determining the number of familiar pieces of furniture in shared rooms. In contrast, some of the content perspective questions showed a need for a more in-depth exploration of the underlying environmental elements, for example, identifying the sources of stimuli provided indoors or outdoors. To address this, additional items were added to the tested version of the G-EAT as well as free text boxes [16].

▶ **Tab. 4** Fulfilment of dementia-sensitive environmental design elements in living units (G-EAT category items).

Dementia-sensitive environmental element	**Percentage of living units that fulfil the element (n)**			
Reduce risks unobtrusively				
	no	**yes**	**yes, unobtrusively**	
Access to kitchen can be restricted	69.1 % (29)	21.4 % (9)	9.5 % (4)	
Resident kitchen has safe appliances	50.0 % (21)	21.4 % (9)	28.6 % (12)	
Resident kitchen has master switch	64.3 % (27)	7.1 % (3)	28.6 % (12)	
Allow people to see and be seen				
	0–25 %	**26–50 %**	**51–75 %**	**76–100 %**
Lounge room is visible from bedrooms	57.1 % (24)	11.9 % (5)	9.5 % (4)	21.4 % (9)
Bedrooms are visible from lounge room	64.3 % (27)	31.0 % (13)	2.4 % (1)	2.4 % (1)
Dining room is visible from bedrooms	64.3 % (27)	14.3 % (6)	7.1 % (3)	14.3 % (6)
Manage levels of stimulation				
Pathway is defined from bedroom to dining room	52.4 % (22)	19.0 % (8)	11.9 % (5)	16.7 % (7)
Window view from bed is attractive	2.4 % (1)	9.5 % (4)	16.7 % (7)	71.4 % (30)
Create a familiar place	**many**	**a few**	**none**	
Proportion of lounge furniture that is familiar	71.4 % (30)	28.6 % (12)	0 % (0)	
Proportion of bedroom furniture that is familiar	69.0 % (29)	28.6 % (12)	2.4 % (1)	
Bedrooms have residents' own decorations/photos	95.2 % (40)	4.8 % (2)	0 % (0)	
Bedrooms have residents' own furniture	66.7 % (28)	33.3 % (14)	0 % (0)	
Links to the community				
	0	**1**	**2 or more**	
Inside, small group areas are available	0 % (0)	9.5 % (4)	90.5 % (38)	
	no	**1**	**2**	**3 or more**
Inside, private conversation areas are available	0 % (0)	11.9 % (5)	31.0 % (13)	57.1 % (24)
	1	**2 or 3**	**4 or more**	
Inside, variety of different areas are available	14.3 % (6)	57.1 % (24)	28.6 % (12)	

In addition, the joint tour of the nursing home with the staff of the participating facilities made it clear that the results were linked to the goals of the respective nursing home as well as the organisational culture and social environment (e. g. opening up the facility to the neighbourhood) and needed to be discussed in this context. On the one hand, this is in line with the intention of the creators of the original instrument to initiate reflection within the team [14]. On the contrary, this is consistent with the findings of colleagues in the Netherlands on the interrelationship between built, social, and organisational aspects of the environment in residential long-term care [22].

Opportunities for assessing context in implementation studies

The abundance of some items in the G-EAT that are associated with regulations for the construction of nursing homes in Germany and the practical benefits of a comprehensive assessment of dementia-sensitive environmental elements seem to contradict each other. Nevertheless, the systematic assessment of the built environment based on evidence-based principles offers an opportunity to look more closely at the construct of the 'built environment' in the future. In addition, implementation studies, e. g. through the recording of contextual characteristics as part of process evaluations, should take greater account of the factors of "the aim of the environment for the care concept" and the heterogeneity of the spaces in the living unit. Frameworks used in implementation research, such as the Consolidated Framework for Implementation Research (CFIR), already capture certain environment-related characteristics and can serve as an example of how to include the environmental context factor in implementation studies [23]. In addition, capturing the context of quality improvement projects in health and long-term care settings could also help focus on the sustainable implementation of the intervention by considering environmental characteristics [24].

Limitations and strengths

The results presented here have some systematic limitations. This is a secondary data analysis of data from a convenience sample of living units limited to the federal state of North Rhine-Westphalia, in which smaller cities/towns could not be included, although facilities belonging to a medium-sized or large city were also located in more rural areas. It should also be noted that the interrater reliability of the G-EAT was first tested with this survey, and then further questions that were not included in this initial exploration were added [16]. The restriction of obtaining balanced information on all the spaces belonging to the living unit also limits the significance of the results. For example, the occasional collection of questions

regarding residents' private rooms poses an ethical challenge to data collection, which must be addressed in future projects.

However, it should be emphasised that the systematic recording and evaluation of the definitions of living units in this study enabled the heterogeneity of settings to be made visible. This contributes to the discourse on the possibilities of interpreting and comparing the types of living units and their effects as locations for implementing interventions.

CONCLUSIONS

The G-EAT can be used to initiate a systematic review of the built environment as a key element of dementia-specific care. The results of the fulfilment of dementia-sensitive key design principles and elements can support multiprofessional care teams in prioritising various refurbishment or redesign activities. To implement dementia-sensitive changes during the day-to-day care of residents, scientifically supported implementation of the G-EAT as an initial assessment tool and redesign process support in nursing homes is required.

Conclusion and outlook for further use of the G-EAT

As described above, the results of this exploration should serve as a basis for a Germany-wide systematic assessment of the dementia sensitivity of living units in nursing homes. In addition, the G-EAT should already be used in practice, but also in health research projects, for example, for a more in-depth description of the contextual factor "built environment". In addition to systematic recording using an assessment tool, it is necessary to focus on the residents' direct perspectives. A qualitative interview study of residents with dementia is currently being conducted to determine how this can be accomplished.

Ethical considerations

The entire study was conducted with the approval of the Ethics Committee of the German Society of Nursing Science (application number: 18–005). This article does not include studies on humans or animals.

Data availability statement

The data collected and/or analyzed in this study are available on request from the corresponding author. The German Environmental Audit Tool was translated and tested by the German Centre for Neurodegenerative Diseases based on the Australian Environmental Audit Tool. Written permission was granted by the developers for authorised use and further development of the original tool.
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Authors contribution

Study design: AF, BH; Recruitment and data collection AF, KS; data analysis: AF; data interpretation: AF, KS, HV, RP, BH; manuscript writing: AF; manuscript review: KS, HV, RP, BH. The corresponding author ensures that all authors have read and approved the final manuscript and meet the ICMJE criteria for authorship.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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