Universal Design 2014: Three Days of Creativity and Diversity
H. Caltenco et al. (Eds.)

doi:10.3233/978-1-61499-403-9-259

The potential of a home modification strategy – a universal design approach to existing housing

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Abstract. The significance of home modifications for ageing populations extends beyond the physical modification of an existing home. This paper discusses the potential for home modifications to impact the process of ageing well. Home modifications apply Universal Design Principles in the targeted and restricted setting of an existing home environment. There is evidence to suggest that home modifications operate on dual levels - addressing broader societal concerns about accessible housing and care demand, while concurrently addressing the individual needs of older people who want to age well in their own home. This paper refers to preliminary findings of an ongoing research project investigating the value of home modifications. It uses a mixed method approach (AQoL utility scoring and thematic analysis) to analyse survey responses from home modification recipients (n=89). Preliminary findings reveal an increase in utility scores following home modifications, this increase in health related quality of life is further supported by the thematic analysis. These results are discussed in terms of the dual role that home modifications play in responding to individual needs and broader society and reinforce that home modifications play a variety of roles in supporting ageing well at home that extend beyond the physical environment. In conclusion, the research supports and contributes to developing evidence that home modifications have the potential to support the changing social needs of Australia's ageing populations in ageing well by impacting health related quality of life and improving feelings of independence, and safety/confidence.

Keywords. Accessibility, home, housing, home modification, home adaptation, universal design

1. Introduction

A majority of Australian housing has been designed and constructed without consideration of Universal Design Principles. This may be attributed to the fact that many of Australia's homes were built in a time when Universal Design principles were neither understood nor recognised. However even newly built housing are not guaranteed to be designed with Universal Principles in mind because of the voluntary nature of Australia's Housing Guidelines and the exclusion of single family dwellings from Access to Premises Standards.

The lack of inclusive housing in Australia continues to contribute to the marginalisation and exclusion of many older people and people with disability [1]. It is acknowledged that Australia needs to increase the adoption of universal design features in new housing development [2] and develop innovative and cost-effective strategies to manage the consequences of an overwhelming majority of non-universally design housing in the context of Australia's ageing population.

1.1. Home Modifications and Universal Design

Universal design is defined as "*the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design*" [3]. Where an existing home has not been designed according to Universal Design Principles, and in order to improve its usability – the adaptations or specialised design modifications made to a residential home to improve a house's usability can be considered *home modifications*. Home modifications (also known as home adaptations or residential modifications) are defined as environmental interventions aiming to support activity performance in the home [4]. In common with the definition of Universal Design, home modifications relate to usability of the environment and have established links with caregiving in the homes of people who are older or living with a disability.

Thus home modifications can be considered the application of Universal Design Principles in the targeted and restricted setting of an existing home environment. They are targeted because they are in direct response to an individual person's health situation (and not a universal environment accessible for all). They are restricted because they must be implemented within the physical constraints of an existing home, within the budget constraints of government or private funds, and within the time constraints of an older person with declining health or mobility.

These apparent limits and restrictions could lead home modifications to be seen as a poor alternative to a new universally designed home. However this paper discusses why addressing the physical environment via home modifications is a strategy appropriate for the current demographic setting of ageing populations and limited accessible housing. Home modifications have the potential to be sensitive to and accommodate the more complex processes of ageing such as our connection to home – 'belonging', and our need for autonomy – 'agency'.

Universal Design, when applied as a guiding principle in the design of a new home can bring whole of life independence, security and mobility- providing the possibility of ageing in place for a longer period of time with greater independence and sense of security. Home modifications may not achieve such comprehensive and universal accessibility within a single home, but they are a solution that is able to address not only the physical accessibility, but the wellbeing values brought about by maintaining autonomy and the values of belonging that explain the desire to age in place. As such they constitute a targeted application of universal design principles to the more obvious barriers within a person's home – according to their individual health and abilities and their existing home design.

The Australian Home and Community Care (HACC) Program defines Home Modifications as *structural changes to the client's home so they can continue to live and move safely about the house. It will often include the fitting of rails, ramps, alarms or other safety and mobility aids*" [5]. Given the strong links between how people age, their desire to age in place in their own home and their changing health and care needs, home modifications have a role to play in introducing the benefits and associated impacts of universal design principles into existing and inaccessible housing.

There is evidence to suggest that home modifications play a multifaceted role in ageing well, in that they have the capacity to impact a person's security, wellbeing, safety [6-8] and caregiving [9].

The dynamics of the processes of 'belonging' and 'agency' within the role of the built environment has been acknowledged and modelled as part of an integrated framework of ageing well [10]. Research underpinning this paper is currently being conducted in Australia and investigates the impact of home modifications (government subsidised) as perceived by the recipients themselves. Preliminary findings from

surveys (n: 89) indicate that home modifications can impact the interdependent factors of physical function, independence and wellbeing. Results indicate that home modifications can measurably improve health related quality of life by providing security and confidence to older people with declining health irrespective of their care needs, and can restore lost independence thus reducing the need for assistance and care.

2. Method

The aim of this paper is to explore the multiple roles and impacts of home modifications in a setting of limited availability of Universally Designed housing. This paper is based on preliminary findings from work conducted by the primary author for a PhD thesis. The research is exploratory in nature and is intended to analyse an understanding of the roles played by government subsidised home modifications. This paper draws on primary data collected from a survey of home modification recipients and takes a mixed methods approach by applying the following analyses:

i) Quantitative analysis of utility scores from health related quality of life data

ii) Qualitative analysis in the form of thematic analysis of comments provided by the research sample about their experiences of home modifications

Surveys were distributed within the state of New South Wales (NSW) throughout the Home and Community Care (HACC) network of Home Modification and Maintenance Service (HMMS) providers. Surveys were sent to recent recipients of home modifications. All respondents received Level 1 Home Modifications, meaning the value of their home modification was less that AU$7500 [11]. Of 450 surveys distributed, 89 responses were received (n:89) and form a sample ranging in age from 52 to 96 years.

The survey sought information on how care needs differed before and after the installation of home modifications as prescribed by an Occupational Therapist. It also surveyed shifts in wellbeing and utility both before and after home modifications. Within the survey, utility scores for before and after home modifications were collected using a validated health related quality of life instrument, the Assessment of Quality of Life (AQoL).

As recent recipients of home modifications within the HMMS network, survey responses could be matched with detailed client files. This enabled rich data such as health diagnosis, carer information, home modification details and costs to be included for future analysis. The data gathered and discussed in this paper includes survey respondents' experiences, utility and rates of wellbeing before and after home modifications.

A variety of instruments are used to measure health related quality of life. In this research AQoL provides a measure of utility. Australian population norms are available for the AQoL [41] which has been validated for use in Australian health studies, being based on Australian data. The AQoL is also considered valid for use in testing older, community dwelling populations [42]. The resultant utility scores are a measure of health related quality of life and are intended to be used in further research involving economic evaluations of home modifications.

There are a number of limitations of the research design which can be attributed to time and budget constraints as well as ethical considerations. Control data was not

included in the research design due to ethical considerations as home modification interventions could not be ethically withheld from those eligible for them. The research design did not have the time capacity to survey recipients longitudinally i.e. before home modifications. Thus data on experiences before and after home modification were captured in a single survey at a single point in time – between one-six months after home modifications were installed. The survey therefore asked recipients to recall their care, wellbeing and utility before home modification as well as report on their current experience. It is acknowledged that such recall can contribute to a level of bias in results.

3. Results

The results are documented in two sections; firstly the quantitative analysis of the AQoL results followed by the thematic analysis of the qualitative data.

3.1. Utility Scores

The AQoL-4D instrument incorporated into the survey design for this research includes 12 questions about the following four quality of life dimensions; Independent Living, Mental Health, Relationships and the Senses. Data from the survey was collated and analysed using AQoL algorithms in SPSS software. Mean utility scores for before and after home modifications are shown in the Table 1 below:

Table 1. Mean utility scores before and after home modifications. Analysed from AQoL-4D data captured in the survey.

Mean Utility score Before Home Modifications	Mean Utility score After Home Modifications	Difference in mean utility
0.394607	0.501685	+0.107078

Table 1 above indicates the adjusted mean utilities were higher after home modification installation resulted in an increase in mean utility score of 0.11. Mean utility can also be analysed according to individual dimensions of AQoL. Table 2 below indicates how utility was distributed for each of the utility dimensions.

Table 2. Individual dimension utility scores before and after home modifications. Analysed from AQoL-4D data captured in the survey.

AQoL Dimension	Mean Utility Score Before Home Modifications	Mean Utility Score After Home Modifications	Change in Utility Score
Independent Living	0.622273	0.722841	+0.100568
Mental Health	0.818636	0.867273	+0.048637
Relationships	0.749773	0.805795	+0.056022
Senses	0.84375	0.874659	+0.030909

Of note, and as might be anticipated, the biggest change in mean utility was in the Independent Living dimension. Levels of self-reported independent living, mental health, relationships and Senses are all important influencers of utility scores in this context.

3.2. Thematic Analysis

The survey sought information about individual experiences of home modifications in the form of an open ended question; "*How had home modifications changed [the respondent's] health and care needs?*". Analysis of the individual comments made by respondents reveals four key themes in a persons' experience of home modifications. Using Nvivo, responses were coded according to these four themes. The results are tabled in Table 3 below.

Table 3. Frequency of key themes within descriptive comments of people's experience of home modifications

Key theme	Frequency of occurrence in responses (total n:89)	Examples of responses
Safety/ confidence	60.6%	"Before the hand rails were fitted I had a few falls. I have gained much confidence through these modifications" *Respondent 46* "The hand rail in the shower is very good - it makes it a lot safer" *Respondent 48* "I had the hand held shower installed. I now can sit down and I feel safe while showering. It makes a big difference as I get breathless and dizzy due to emphysema." *Respondent 58*
Mobility throughout home	58.4%	"I can now manage the two steps at the back door alone and am able to shower without difficulty" *Respondent 32* "The rail that has been installed helps me a lot to balance myself upon getting around to the toilet straight from my bed and I feel stable to walk." *Respondent 12* "I get about house better and enjoy a shower again." *Respondent 57*
Independence	10.1%	"The change in my shower is great. I can hang on and stand up and wash myself better now." *Respondent 40* "Hand rails have made showering and going to toilet easier, less reliant on family members - less dangerous and safe to have shower now." *Respondent 3* "The bathroom rails have provided me with the confidence to shower by myself and help regain a little independence" *Respondent 38*
Community participation	7.8%	"Since I have had my ramp I am able to walk about outside the house with my walker. I have improved in health and feel happier" *Respondent 68* "Things are easier at home. For the first time in 4 years I have been to the movies." *Respondent 12* "I [received] a stepped ramp from the hall to the garage (instead of two steps). So I could get my walker to the car if and when needed." *Respondent 41*

The strongest themes were 'Safety/Confidence' and 'Mobility throughout home' followed by 'Independence'. Utility scores in the AQoL do not include the 'Safety/Confidence' and 'Mobility throughout home' nuances but one might assume that some of this would be detected under the broader independence dimension. The

thematic analysis clearly supports the quantitative findings obtained from the AQoL assessment of Quality of life. A theme of community participation was evident and may be accounted for in AQoL utility in the relationship dimension. Further analysis is needed to triangulate and unpack potential correlations across measures.

4. Discussion

The results from the survey indicate that home modifications impact recipients in a number of overlapping ways and impact health related quality of life. Not surprisingly, the detected increase in utility is most evident in the dimension of *independent living*, and to a lesser extent in the other three dimensions of mental health, relationships and senses which also reflect a positive change in their mean utility score. The thematic analysis of survey comments further support these utility score results, with increased independence, mobility and safety/confidence being recorded as the strongest themes within people's experience of home modifications. These results are in line with the developing body of evidence across the fields of housing and health that describe how the application of Universal Design principles in the form of *home modifications* have the potential to impact society and individuals.

4.1. Societal Impacts

Home modifications play an important social role in managing the support needs of Australia's ageing population, enabling people to age at home independently by:

- Improving the accessible housing supply [13]
- Supporting care provision, both formal and informal [25]

Provision of more housing that is in line with Universal Design Principles means a greater proportion of housing can better support ageing in place, offsetting some pressure on institutional care. Home modifications can support caregiving in the home and even substitute for care in the home which reduces the pressure on care networks to provide high levels of care in an inaccessible setting.

4.1.1. Accessible Housing Supply

The implications of a predominantly inaccessible housing supply have been raised across both housing and health sectors. Only 2% of Australia's housing is newly built each year [12]. This is significant given that only a small proportion of that 2% will consider Universal Design principles embedded in Australia's Livable Housing Guidelines[1]. Therefore Australia is faced with a compounded health and housing crisis in the form of inaccessible housing and an ageing population [1, 13]. Housing is recognised as an important contributor to a person's health, wellbeing and social participation levels [6, 13].

Australia's current housing supply is poorly equipped to meet the needs of Australia's changing population [14]. This lack of inclusive housing in Australia continues to contribute to the marginalisation and exclusion of many older people and people with disability [1, 15, 16]. These concerns reflect a need to increase the adoption of universal design features in new housing development [2] and also to strategise how to manage an oversupply of inaccessible housing and the consequences for all residents. There is evidence to suggest that home modifications can play a role in ameliorating some of the consequences of inaccessible housing by directly

[1] Australian Livable Housing Design Guidelines
www.livablehousingaustralia.org.au/design-guidelines/

addressing independence and selfcare. Home modifications have the ability to improve levels of selfcare in the home for those who are older or living with a disability [17-19]; Almost half (50%) of the difficulties with daily activities experienced by older people can be overcome by modifying the environment [20].

4.1.2. Reducing demand on caregivers

Changing health needs as people age can trigger an inability to perform some tasks independently at home, particularly if the home is not designed according to Universal Design principles. When care becomes necessary in the home it is performed informally by family members, or formally by paid caregivers.

A developing body of evidence supports how home modifications substitute for caregiving in the home [21-24] and reduce the likelihood of entering residential care [27]. This has particular significance in Australia given the anticipated spike in demand for formal care services and a projected inability to meet this demand [25, 26]. This reduction in the need for care following home modifications takes place as selfcare practices are enabled [28].

4.2. Impacting individual recipients

Home modifications can reduce the need for care and facilitate selfcare [21, 23, 29, 30]. Both of these impacts are linked to a sense of independence and wellbeing [31]. Home modifications have the potential to impact the individual lives of people ageing in their own home by:

- Supporting physical independence at home
- Improving sense of wellbeing, autonomy security and safety

Maintaining independence is recognised as an underpinning feature of successful ageing in place [32, 33]. There is substantial evidence that older people, particularly home owners, want to age in place, and to do so independently [34]. There is also evidence to suggest that the independence offered by home modifications can result in greater feelings of wellbeing and autonomy [8]. This supports the ability of home modifications to impact independence levels. Preliminary findings from the survey in the thematic analysis also support the ability for home modifications to improve independence in daily tasks. Participants' responses indicate that the modifications have made them feel more independent in aspects as varied as moving from house to outside, showering, or moving around the house.

4.2.1. Home modification and ageing well – the measurement of wellbeing

Ageing well is defined as *maintaining the highest autonomy, wellbeing and preservation of one's self and identity even in the face of severe competence loss [10]*. Ageing well is significantly influenced by both the physical environment and the agency and belonging that an environment represents. Given that a majority of the older population want to remain at home as they age, ageing well is closely associated with ageing in place *[35]*. Discussions on the topic of home modifications have tended to examine only the physical aspects of the environment obtained through improving accessibility and restoring function [8].

Conversely theories of ageing have failed to give adequate attention to how the physical environment influences the impact of the ageing process, focusing more heavily on social aspects of ageing [36]. However more recent research into theoretical models of healthy ageing and housing recognise that housing is more than simply a physical space to perform tasks [10, 18], and acknowledge the importance of how a

person feels about an environment. Such theories recognise the additional roles of 'agency' (autonomy) and 'belonging' (connection to place) along with physical environment. As the results indicate, levels of wellbeing felt by older people living at home are associated with home modification recipients' feelings of safety [37]. Feeling unsafe in the home and in the performance of everyday life activities poses a threat to ageing in place [38].

4.3. Recognising multiple impacts of home modifications

Home modifications align with the basis of Universal Design principle, that is, 'to make our built environment, products, and systems as enabling as possible' [39, 40]. The aim of this paper is to acknowledge multiple roles and impacts of home modifications in a setting of limited availability of Universally Designed housing. The results of utility scores coupled with thematic analysis indicate that home modifications improve health related quality of life, and can specifically improve mobility, independence and feelings of safety and confidence within the home. These results support the evidence base which builds a suite of roles for home modification across fields of both housing and health. These include both roles impacting society and the individual.

Three distinct roles emerged from the survey responses relating to how people felt Level 1 home modifications had impacted their lives; improving safety/confidence improving mobility, and improving independence. Community participation was detected as another theme to a lesser degree. Thus Level 1 Home Modifications have the potential to improve levels of mobility around the home, improve sense of safety as they perform basic daily tasks such as toileting or showering and they increase people's ability to perform tasks independently. This has ramifications for both formal and informal caregiving (such as spouses or other family members) which will be explored in further research analysis of the collected data.

At the core of the interaction between an older person experiencing health decline and their relationship to their home is the processes of belonging and agency. These two processes explain in part our desire to stay at home as we age, and the decline in wellbeing as we lose independence or autonomy in our daily lives. These two processes can be impacted by the built environment and as such are addressed and acknowledged in Universal Design Principles.

5. Conclusion

Although Universal Design principles can be more holistically integrated into newly designed homes many developing countries are in a situation where populations are ageing rapidly, a high percentage want to remain in their existing housing as they age, but a very high proportion of existing housing is inaccessible, fails to integrate Universal Design principles. A consequence of ageing in a non-universally designed home is that people are experiencing the loss of confidence, the risks of falling and the lack of mobility associated with the ageing process in homes that through their inaccessibility, compromise their sense of independence, mobility and safety.

As previously disparate research areas of ageing theory, universal design theory and housing being to converge, strategies such as home modifications can begin to be recognised and valued for the multiple roles they play. This research supports developing evidence acknowledging not only how modifying the built environment impacts our ability to physically function but also the importance of agency (autonomy) and belonging (connection to space) by responding directly to the desires

of people to age in their own homes. In conclusion the research suggests that home modifications informed by Universal design principles can support the changing social needs of Australia's ageing populations by meeting the complex, multi layered and individual needs of older people as they continue to age and provide an opportunity to impact wellbeing, caregiving, independence, safety and security.

6. Further Work

In order for home modifications to be valued across disciplines, the development of a model that compares environmental changes with measurable aspects of agency and belonging are required. This paper is based on preliminary results from Level 1 home modification data. A detailed examination of the costs, values and substitutions associated with home modification across all levels is planned for as part of an ongoing research project. This ongoing research will enable a clearer understanding of how wellbeing levels impact the value of home modification, and will present an evaluation model that acknowledges both the physical role and lesser understood role of wellbeing to capture the range the benefits that home modifications have the potential to deliver.

7. Acknowledgments

This work was supported by an Australian Postgraduate Awards (APA) Scholarship and a grant from Australian Housing and Urban Research Institute (AHURI) in the form of a top-up scholarship. We thank Mr Fred Zmudzki, health economist and Director of Epoque Consulting, for his advice regarding health related quality of life instruments.

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