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Transdisciplinary Development of a Framework for Co-Creation With People Living With Dementia

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Abstract
When aiming for built environments and systems that foster resiliency and resources, one of the most crucial aspects of design is to properly address the users' needs. While comprehensive research and an empathetic mindset are important prerequisites of this process, the inclusion of all relevant stakeholders cannot be compensated by any methodology. With regards to co-creation with people with dementia, this can pose additional challenges as participants might have difficulties to articulate their feelings and thoughts or design teams might struggle to come up with interactive formats that fit the current mental and physical abilities of the participants. Therefore, understanding key requirements and principles that are particular for the field of neurodiversity can be of great help in order to successfully engage users in the design process. In this paper we outline a transdisciplinary research process conducted by scholars from UCL in cooperation with other stakeholders from academia and practise. This multi-stage process aimed at creating a framework for developing co-creation workshops and approaches for people living with dementia and other forms of neurodiversity.

Keywords: Co-Creation, Transdisciplinarity, Design and Dementia, Built Environment

Introduction - Addressing the specific context of dementia und neurodiversity in co-creation sessions

One of the most crucial challenges of design is to address the needs and requirements of all user groups related to the design output. This applies in particular to designing objects, spaces and systems that aim at serving vulnerable user groups such as people living with dementia and their caregivers. In recent years, actively involving various stakeholders – including patients, caregivers and service providers among others – proofed to be of significant usability, as it allows design teams to gain first hand knowledge of the context without being biased by their own ideas (e.g. Sanders & Stappers, 2014).

Co-design or co-creation intensely involving participatory approaches can be playful and low-threshold methodologies in complex design processes. However, when being applied together with people living with dementia or other forms of neurodiversity, new challenges arise that need to be addressed by design teams when developing co-design workshops (see e.g.Hendriks et al., 2015).

In order to facilitate this process of planning and conducting user-centred co-design workshops that include people living with dementia, a group of researchers, practitioners and both professional and informal caregivers from various institutions and countries participated in a mult-session research- and transferproject that aimed at creating a framework for developing co-design workshop with people living with dementia[1]. The major focus of this project was the design of the built environment. While some aspects might apply to other topics of co-creation with people living with dementia, this was not explicitly object of attention.

In line with current transdisciplinary research approaches (e.g. Defila & Di Giulio, 2019; Belcher et al, 2019) this project was conducted in close collaboration of experts from academia, practise and personal experience. In this way both scientific evidence and anecdotal and implicit knowledge could be taken into account. Furthermore, specific results and concepts where continuously evaluated and adapted from both a scientific and practical point of view.

A multi-session process for creating the framework

The overall process comprised four separate phases in which different experts provided knowledge and shared experienced before insights where consolidated and merged into a framework. All steps where performed online.

Phase 1: Panel presentations by early career academics

In this first phase, early career academics from various fields such as architecture or psychology presented methodologies and approaches for co-creation. These presentations purposely did not focus in particular on people living with dementia. While this was neither excluded nor required, the main focus in this phase was to collect and discuss the approaches

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[1] Let's not forget those who forget! What individuals with dementia think of the design of their living environment? The project is funded by UKRI, UCL Grand Challenges and the Knowledge Exchange Innovation Fund. Principal Investigator: Dr Evangelia Chrysikou; Co-Investigators: Dr Dorina Cadar & Dr Mine Orlu (University College London). For more information visit:: https://iris.ucl.ac.uk/iris/browse/researchActivity/30981 (last checked 15th of August 2022)

and their unique potentials and limitations with regards to the element of including user groups.

Phase 2: Round table discussion with experts & SWOT analysis

Subsequent to this, a round table discussion with experts in the field of dementia and neurodiversity was conducted. This discussion was moderated focusing on understanding the needs and requirements of people living with dementia and their caregivers.

In contrast to the panel presentations, here co-creation was not the major focus point. However, ideas and aspects that related to co-creation where occasionally addressed.

Parallel to this round table discussion a virtual whiteboard displaying a SWOT-template was used to collect insights and statements regarding "Strengthes", "Weaknesses", "Opportunities" and "Threats" of co-creation with people living with dementia related to the needs and requirements of this vulnerable user group. More precisely, the field of "Strengthes" elaborated on the questions "What are the benefits when co-creating with people living with dementia?". "Weaknesses" related to "needs to be considered". "Opportunities" describe aspects that "create an added value when co-creting with people living with dementia?". In this context, "Threats" referred to "What might be risks and difficulties regarding the co-creation process?".

This SWOT-chart was complemented with a field for "advice for co-creation & built environments" and "other notes…".

The whiteboard was filled-out by a scholar simultaneously during the round table discussion.

Phase 3: 3h-Workshop with early career academics and experts

Based on both the panel presentations (phase 1) and the round table discussion (phase 2), a workshop was conducted that aimed at revisiting the insights gained so far and consolidating them into a applicable framework. Therefore, the explicit goal of this workshop was to "Create a framework for developing co-creation workshops for and with people living with dementia & neurodiversity – focusing on the built environment".

During this workshop, participants discussed and brainstormed further key insights and important issues derived from the round table discussion using the extended SWOT-diagram.

In a second step co-creation approaches and tools were collected and discussed based on the panel discussion and own experiences.

In a research-based brainstorming all participants then collected and grouped general aspects that should be considered when developing co-creation workshops for people living with dementia in a mindmap.

Finally, during a focus group discussion participants ideated relevant phases in a co-creation session and useful tools and methods while considering the specific needs and requirements of people living with dementia.

Phase 4: Follow-up workshop iteration

Since both the mindmap of general aspects and the table of phases proofed to be highly complex, a second workshop with partly difference early careers and experts was conducted to deepen the knowledge and practicability of both tools.

Output

A. Building Blocks and Considerations

One of the two major outputs of this process is a mindmap illustrating the building blocks and considerations for co-design workshops for and with people living with dementia. The herewith presented version (see Fig. 1) is still work in progress and currently updated by the project team.
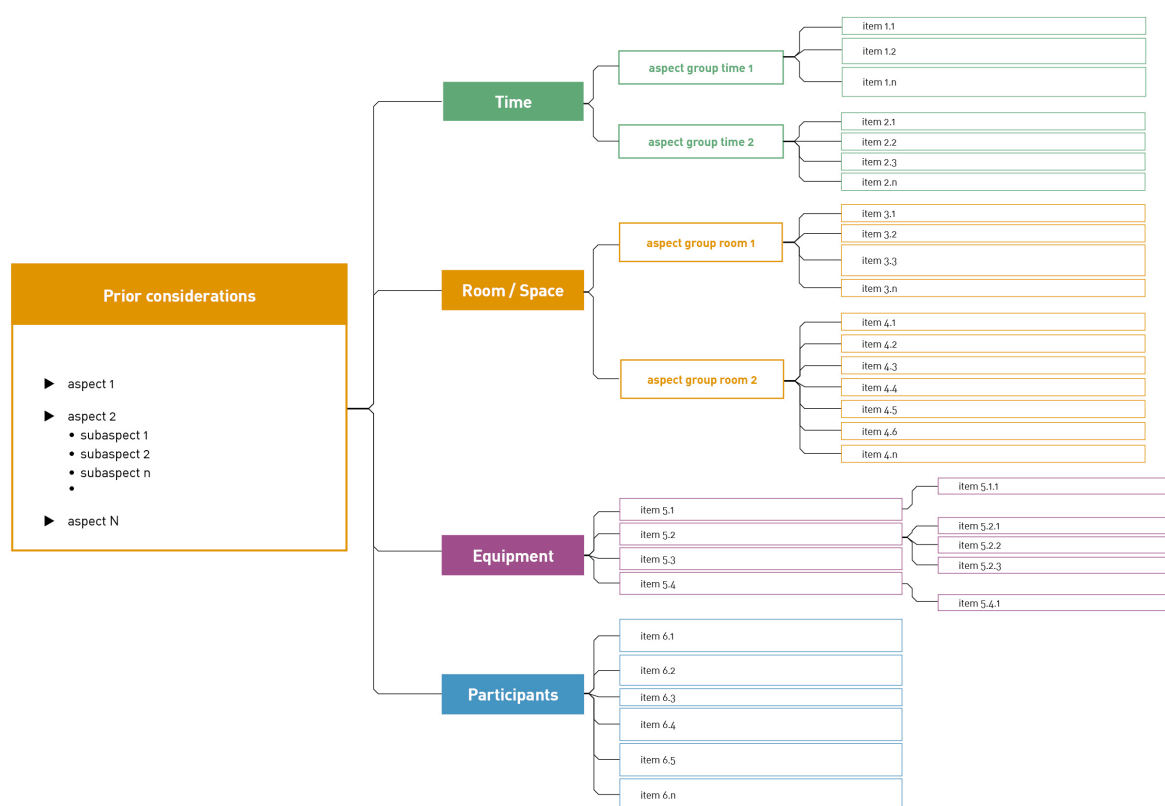
Figure 1: A Building Blocks and Considerations for Co-Design Workshops for and with People Living with Dementia. (interim version)

B. Phases and Tools

Secondly, a table comprising phases and tools for co-design workshops for and with people living with dementia was developed (see Fig. 2 for an interim version of this framework). This is a open-ended framework that is currently being updated and extended by the project team. Furthermore, this table is meant to be a basic structure which needs to be adapted and extended with regards to the individual and unique project and group of users at hand.
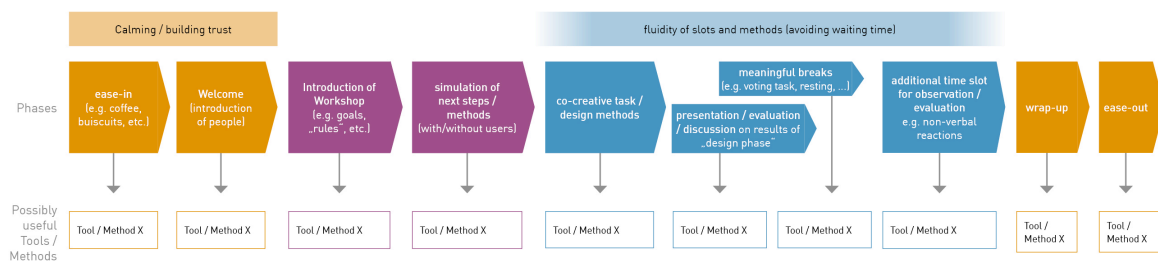
Figure 2: B. Phases and Tools for Co-Design Workshops for and with People living with Dementia. (interim version)

Conclusion

This transdisciplinary process proved to be highly interactive and led to new insights that most likely would not have been derived from several workshops with disciplinarily separated groups of participants. The heterogenic mix of scholars, practitioners and informal caregivers created synergies and emergent knowledge partly built on implicit knowledge of the experts.

However, it is worth mentioning that the herewith presented mindmap and table is a first and interim version of the framework that is currently updated and extended. Therefore, these tools are at the moment the mere basis for scientific discussion before they are rolled-out to the public to be applied in real life workshop scenarios by design teams.

Therefore, more research is needed to evaluate the use and effectiveness of this framework once it is finalized and published.

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Quality of Life of Elderly With Vascular Illness and the Level of Depression in 4 Barangays in Malabon, Philippines

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Abstract

Seniors or elderlies are a growing number all over the world, and they also have sicknesses like diabetes, high blood, and high cholesterol. Having chronic illnesses can affect the mood of the elderly: becoming cranky, lonely, not eating, etc. Therefore, there is a need to study the relationship between the quality of life of the elderly and their level of depression. Depression for the elderly is known as vascular depression since it is tied to vascular illnesses like high blood, high cholesterol diabetes. The study wanted to determine the relationship between quality of life and depression for those having vascular illnesses. This was done in Malabon, Metro Manila, Philippines, for two hundred eighty-seven (287) seniors ages 60 and above, in four (4) barangays, who were getting their free medicines for their vascular diseases for free at the barangay health centers, coming from the Department of Health. Two instruments were used; quality of life (CASP-19) based on needs satisfaction and a patient health questionnaire (PHQ-9), which determines depression severity. The finding showed then there was a very significant negative correlation between the quality of life to depression using Spearman rank correlation. It means that when the quality of life is high, the level of depression is low or vice versa. The seniors were happy with their families and friends, can overlook their diseases, and did not suffer from depression.

Keywords: CASP-19, Depression, Quality of Life, PHQ-9, Elderly

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Introduction

The World Health Organization defined quality of life (QoL) as individuals' perceptions of their position in life in the context of their culture and value systems, and concerning their goals, expectations, standards, and concerns ("Meaning Quality of Life," n.d.). Furthermore, the quality of life refers to the subjective life satisfaction and well-being of the individual. It is important to learn about QoL because interventions and programs can be provided to clients or patients who need to improve their situations, and prevent serious consequences ("Why is quality of life important," 2018).

In the Philippines, there is an increasing population of senior citizens. In 2000, there were 4.6 million: 60 years old and above, 6% of the total population; and in two decades: 9.4 million, 8.6% of the total population ("Ageing population in the Philippines." 2019). In 2021, the current life expectancy is 71.4 years old, an increase of 0.18% from 2020 ("Philippine Life Expectancy 1950-2022", n.d.); however, this aging population of the country necessitates the government to address various elderly-related issues like rehabilitation, depression, daily activities, and health care according to the Executive Director Juan Perez III of the Commission on Population (Crisostomo, 2015).

Depression remains still underdiagnosed and undetected due to a lack of mental health workers in the Philippines. The ratio per 100,000 of the general population is 0.5 psychiatrists, 0.07 psychologists and 0.49 mental health workers. There are 37 psychologists out of 27 hospitals, and 160 certified geriatricians mostly residing in Luzon (Pellejo, et al., (2020).

Depression is an emotional or mood disorder that happens when there is a prolonged feeling of loss, and unhappiness; sleep deprivation; loss of appetite (Huxley, 2021) due to psychosocial factors like bereavement, caregiver burden, and lack of social support (Halverson et al., 2020); or illness like cerebrovascular and cardiovascular diseases (Alexopoulos, 2019).

Depression is seen more occurring in the elderly, and this is somehow ignored in society because of the thinking that depression is part and parcel of the experience of getting old, similar to other illnesses like diabetes, high blood pressure, high cholesterol, etc. (Avasthi & Grover, 2018; Diniz & Teixeira, 2019).

Contrarily, according to "Depression is Not Part of Growing Older" (2021), depression is not a normal part of aging, but it is a debilitating illness that is treatable. The consequences of untreated or partially treated depression has higher mortality from both suicides (Van Orden & Conwell, 2012), and medical illness (Aziz & Steffens, 2013).

Depression can hamper a good quality of life. Based on the study in different countries where there are increasing senior population, in India, Portugal, Turkey, Ethiopia, Spain, and Europe, depression is linked negatively to the quality of life. Avasthi and Grover (2018) in India, reveal that depression in the elderly results from difficulties with activities of daily living, premature death, cognitive impairments, and poor quality of life. From Portugal, Ribeiro et al. (2020) claim that screening and treating depression in the elderly would result in a better quality of life. On the same contentions, Onat et al. (2014) state in Turkey, that there is a negative relationship between depression and quality of life, the increased risk of depression can result in a negative quality of life. Similarly, In Ethiopia, Shumye et al. (2019) say that the scores of

those who are suffering from depression have also a low quality of life scores. Likewise, based on Portellano-Ortiz et al. (2018) depression is linked to the quality of life for people over 65 years in Spain and Europe. The low quality of life score is associated with high rates of depression, financial scarcity, low physical health, low educational attainment, and inability to do activities of daily living (ADL).

In the Philippines, life satisfaction or quality of life for older Filipino adults based on the Longitudinal Study on Aging and Health in the Philippines (LSAHP) show that majority of the population are satisfied with their lives. Life satisfaction is a subjective measure of a person's overall evaluation of life-based on subjective and objective conditions being experienced (Ogena, 2019). However, depression is experienced by some older Filipino people, and women are showing more depressive symptoms than men (Natividad, 2019). As of this writing, there is no conducted locally associating quality of life with depression in the elderly with vascular illness in a community setting; thus, this study is a proponent in these areas.

The foundation of this study emanated from the theory of hierarchical needs or motivation by Abraham Maslow, and the unified model of depression by Aaron Beck and Keith Bredemeier.

Hierarchical needs or motivation theory proposes that human beings are governed by needs that motivate them to act and satisfy these needs. These needs are considered hierarchical because the needs are starting from lowest to highest: physiological, safety, love and belonging, esteem, self-actualization, and self-transcendence (Maslow, 2015). Older adults would strive for self-actualization having achieved the other lower needs. Self-transcendence, the highest motivation, permits the individual to relinquish personal comfort for the benefit of others (Koltko-Rivera, 2006).

The unified model of depression: integrating clinical, cognitive, biological, and evolutionary perspectives by Aaron Beck and Keith Bredemeier in 2016, talks about the numerous contributing factors of depression. It consists of clinical, cognitive, and biological approaches that clarify the symptoms of depression and its natural course from its predisposition. Stressful life events heightened reactivity to stress, and deep-seated cognitive biases can lead individuals to espouse negative beliefs about the self, the world, and the future – a combination known as the cognitive negative triad. When activated by stressful life events or affected by severe pain from chronic illness, these beliefs can trigger consistent emotions such as sadness, anhedonia, and guilt; and behavioral and physiological responses such as withdrawal, inactivity, and loss of appetite. External factors such as support from friends and family; guidance from a psychotherapist, and biological treatment through medicines can reverse the cycle of depression.

The study was focused on determining the relationship between the quality of life and levels of depression of Filipino senior citizens of barangay Longos, Potrero, Catmon, and Tonsuya in Malabon City who were availing of free medicines for ailments like diabetes, hypertension, and high cholesterol; and medical check-ups given by the Department of Health (DOH) in their barangay health centers. The respondents of the study were physically abled and mentally alert and gave their consent, to take the survey questionnaires: Control, Autonomy, Self-realization, and Pleasure-19 (CASP-19) to measure the quality of life, and Patient Health Questionnaire-9 (PHQ-9) to measure the depression severity.

The quality of life components has nine (9) different connected domains (van Leeuwen et al., 2019). These are health perception, feeling healthy and not limited by physical condition; autonomy, being able to manage oneself, retaining dignity, and not feeling like a burden; role and activity, spending time doing activities that bring a sense of value, joy, and involvement; relationship, having close relationships which make one feel supported and enable to mean something for other; attitudes and adaptations, looking on the bright side of life; emotional comfort, feeling at peace; spirituality, feeling attached to faith, and self-development from beliefs, rituals, and inner reflections; home and neighborhood, feeling secure at home and living in a pleasant and accessible neighborhood; and financial security, not feeling restricted by financial situation.

One of the most problematic areas of quality of life for Filipino elderlies and non-Filipinos is the lack of money (Netuveli et al., 2006; RongSa et al., 2020; Rathnayake & Siop, 2015; Kumar et al., 2014; Cruz, 2019; Badana & Andel, 2018; de Guzman et al., 2015; De Leon, 2014). Health is the second important consideration for elderlies (Lu et al., 2020; Lin et al., 2014; Netuveli et al., 2006; Rong et al., 2020). Meanwhile, money and education help keep oneself healthy (Chan, 2018; Badana & Andel, 2018; De Leon (2014), Bustillo, 2016; Onunkwor et al., 2016).

Elderlies adapt and accept their degenerative conditions through positive attitudes, resting, physical activities like gardening and exercise, community services, skills training for livelihood, getting access to free programs and services of the government, part-time work, and social interaction with their children and other family members. All of these are factors that can increase the quality of life (Lowsky et al., 2014; Sivertsen et al., 2015; Badana & Andel, 2018).

Social interactions and relationships with family and friends give happiness and satisfaction to Filipino seniors (Beliran & Legaspi, 2014; Valero et al., 2021; de Guzman et al., 2015; Netuveli et al., 2006; De Leon, 2014; Badana & Andel, 2018; Onunkwor et al., 2016). Depression also happens due to a lack of financial resources, health problems, and loneliness (Kumar et al., 2014; Halverson et al., 2020; Sare et al., 2021; Rathnayake & Siop, 2015; Carandang et al., 2019).

Unless its genetics and exacerbated by life misfortunes, depression can be mitigated by good coping strategies and high quality of life (Boone et al., 2010; Carandang et al., 2019; Sivertsen et al., 2015; Valero et al., 2021; Netuveli et al., 2006; Beliran & Legaspi, 2014; Badana & Andel, 2018; De Leon, 2014; Chua & de Guzman, 2014; Bustillo, 2016; de Guzman et al., 2015; Onunkwor et al., 2016; Chan, 2018; Gupta et al., 2014; Netuveli et al, 2012; Rashid & Monan, 2013). It is given that elderlies are going to be feeble as they grow older, however, there is heterogeneity in them (Vaillant, 2015; Fontana et al., 2008; Garcia & Miralles, 2016; Lowsky et al., 2014). Physical and mental exercises, good nutrition, vitamins and minerals, harmonious relationship with others, and available assistance to seniors, can improve quality of life, and lessen depression.

Methods

The researcher used descriptive and correlation research methods. The descriptive research method gives a relatively complete picture of what is occurring at a given time. Descriptive research gives static pictures. Frequency, percentage, and median are examples to describe the respondents.

The median was used as a measure of central tendency for the responses on each item measuring the two variables, the quality of life and depression. The median is good to use if the data is ordinal, like in the data set, the median is computed by taking the mean of the two middlemost numbers (Stapel, 2021). The median is good to use if the data is ordinal like in the Likert scale similar to the questionnaires, CASP-19 and PHQ-9. The median has more power than the mean when the data set contains outliers or very small or large values in the data set (Rumsey, 2021). Normality tests using the Shapiro-Wilks revealed that the research data do not follow the normal distribution. The mean is not appropriate in such situations where the data are skewed. Median, in this case, was the appropriate statistical tool that represented the middle or center of distribution of the whole set of data (Boslaugh, 2021; Brase & Brase, 2015).

Spearman rank-order correlation was utilized the identification the relationship between quality of life and depression. The Spearman rho is a non-parametric measure of the strength and direction of association that exists between two variables measured on at least an interval scale (Hanneman, Kposowa & Riddle, 2013).

 There were 287 elderlies from the four barangays of Malabon City namely Longos, Catmon, Tonsuya, and Potrero. Logistics and data facilitation were the primary considerations in choosing these barangays. Through purposive or judgment sampling, the respondents were selected using the qualities corresponding to the nature and need of the study. According to Lund (2012), and Palinkas et al., (2016), purposive or judgment sampling uses the unique qualities of the respondents as the bases of selection. In the study, the respondents were elderlies or seniors who were claiming for free medical check-ups, and medicines provided by the barangay health centers, and the Department of Health. Through the assistance of the following medical frontliners or nurses namely: Katrina Vianca C. Busa of Barangay Longos; Florica B. Dela Cruz of Barangay Catmon; Ferdinand Ramirez of Barangay Tonsuya; and Reynalyn T. Villarosa of Barangay Portrero, the respondents were informed about the conduct of the study. The researcher also considered the respondents' good mental and physical conditions, and consents. Those who were not willing, and were not able to come in the locale to participate were excluded from the population of sample.

The instruments utilized for this study were Control, Autonomy, Self-realization and Pleasure-19 (CASP-19), and Patient Health Questionnaire-9 (PHQ-9). These survey questionnaires were translated to Filipino by Mr. Ligaya Cotanda, a senior public high school Filipino teacher and a college instructor.

CASP-19 was created by Martin Hyde, Richard D. Wiggins, Paul F. Higgs, and David Blane of the Department of Social Science and Medicine, Imperial College of Science, Technology and Medicine, London, United Kingdom (Hyde et al., 2003). CASP-19 was the satisfaction quality of life questionnaire based on Maslow hierarchy of needs on health and well-being (Sim et al., 2011).

Patient Health Questionnaire-9 (PHQ-9) was a self-administered, diagnostic screening instrument used by health care professionals for assessing and monitoring depression severity. This was made by Dr. Robert Spitzer and Janet Williams from Columbia University, and Dr. Kurt Kroenke from Indiana University with Pfizer from 1999 to 2009 ("Pfizer To Offer Free Public Access," 2010).

Discussion

Table 1 presents the quality of life of the respondents categorized on age, sex, and civil status. The majority of the respondents have a positive quality of life.

Table 2 presents the percentage levels of depression of respondents. Two hundred three (203) or 70.73% of the respondents show none and minimal depression, fifty-seven (57) or 19.86%, mild; twenty-one (21) or 7.32%, moderate; five (5) or 1.74%, moderately severe; and one (1) or 0.35%, severe.

Table 3 presents several significant negative correlations between the quality of life and levels of depression of senior citizen respondents. Based on the results, the Spearman rho has a level of significance at $p<0.05$ and very significant at $p<0.01$ which means that control, autonomy, pleasure, and self-realization, as qualities of life, have a negative correlation to hopelessness, sleep, fatigue, guilt, thinking, agitation, and suicidal ideation. This negative correlation according to McLeod (2020) is the relationship between two variables that when one variable increases, the other variable decreases, and vice versa. These results connote that the respondents have high scores in their quality of life, and their depression is low.

Based on the findings of the present study, a wellness program, Table 4, is made to further strengthen senior citizens in terms of improving their quality of life.

The limitation of the study lies in that it is from a small sample size, 287, and focused on 4 barangays of Malabon. Another extension can be those residing in the province, elderlies suffering from cardiovascular illnesses, to find out if there is a difference between those in the city and the province.

Conclusion

1. The respondents had a high quality of life. The control, autonomy, self-realization, and pleasure domains were met by the respondents in their lives.

2. The levels of depression of the respondents were none or minimal. Only a few were showing mild, moderate, moderately severe, and severe depression.

3. The relationship between the quality of life and the levels of depression had an inverse association which meant that the elderlies with a higher level of quality of life had no or minimal level of depression.

Recommendations

1. To maintain a high quality of life, elderlies should continue with what they want to do; they should make themselves busy; they should take regularly their maintenance medicines as prescribed by their attending physicians; they should live with their family members to address the other needs, and they should stay positive.

2. To ward off depression, the elderly should focus more on their families; they should also attend to their hobbies; desires; and social activities that will prolong their enthusiasm to go on with their lives.

3. To further preserve the quality of life and lessen the levels of depression, a wellness program was proposed to address the needs of the elderly.

4. Future researchers could use this study as a reference for their future studies.

5. A similar study can be conducted to verify the results of the present study.

6. Another study to identify the relationship between the quality of life and healthy aging of different age groups may be conducted.

Appendices

Table 1
Median of Quality of Life of Respondents
based on Age, Sex and Civil Status

Category	No. of Respondent	Quality of Life (median)	Verbal Interpretation
Ages 60-69	159(55.40%)	45	High level
Ages 70-79	106(36.93%)	44	High level
Ages 80 and above	22(7.67%)	41	High level
All	287(100%)	44	High level
Male	103(35.89%)	44	High level
Female	184(64.11%)	45	High level
Married	144(50.17%)	45	High level
Single	143(49.83%)	44	High level

Table 2
Percentage of Levels of Depression of Respondents

Levels of Depression	No of Respondents	Percentage
How many are none or minimal?	203	70.73%
How many are mild?	57	19.86%
How many are moderate?	21	7.32%
How many are moderately severe?	5	1.74%
How many are severe?	1	0.35%
TOTAL	287	100.00%

Table 3
Correlation Matrix on Quality of Life and Levels of Depression
of Senior Citizen Respondents

	Control	Autonomy	Pleasure	Self-realization
Loss of Interest	-.102	-.154**	-.122*	.047
Hopelessness	-.162**	-.236**	-.174**	-.232**
Sleep	-.158**	-.243**	-.091	-.076
Fatigue	-.207**	-.322**	-.147**	-.240**
Appetite	-.052	-.128*	-.040	-.054
Guilt (Worthlessness)	-.132**	-.272**	-.175**	-.144**
Thinking	-.138**	-.181**	-.105*	-.144**
Agitation	-.165**	-.220**	-.135*	-.175**
Suicidal Ideation	-.133**	-.160**	-.113*	-.114*
Overall	-.208**	-.336**	-.103	-.165**

Legend;:
** Significant at $p < .01$;   * Significant at $p < .05$

Table 4
Proposed Wellness Program

Finding	Objective	Activity	Learning Outcome
Quality of life indicator- Control			
There is control found for the elderlies in terms of planning for their future, their age is not affecting their work and life happenings are within their control	To strengthen planning for the future.	Identify by writing or listening to elderlies with regards to the most important goals for the future and focus on them.	Ask the elderlies if their plans for the future are reachable and feasible Ask the family, friends of the elderlies on how the elderlies are doing with their plans.
There is a need to need to remember where they left off things	There is a need to strengthen memory	Have a permanent place for wallet, keys, eyeglasses, and other valuable objects e.g. A container on the table like plastic or paper box for keys, eyeglasses, and wallet	Ask the family, friends, neighbors, or the elderly themselves if there is improvement in remembering where things are placed
		Give mental exercises like playing chess; pompano chess club-halaan alley in Longos, Malabon; playing Sudoku online; card games; or booklet	Ask the elderlies or their caregivers if these mental exercises helped them sharpen their memory.

Finding	Objective	Activity	Learning Outcome
		The following exercises can strengthen both mental and physical aspects: Walking at Pinagsabugan Linear Park, C4 Island Park, Malabon People"s Park; and Aerobics and Zumba at C4 Island Park, Malabon People"s Park, Tanong basketball court.	Ask the elderly or their relatives if their memory and physical strength are improving. To ask the elderlies, if there is improvement in their memory
		To teach the elderlies mindfulness, ie. Keeping focus on where they had kept the important things	Ask the elderly, "Is mindfulness easy to do?
		Provide elderlies with reading materials that have large fonts. This can be provided by barangay libraries.	Ask the seniors if reading is fun and worthwhile. Ask the LGU to provide venues for mental exercises like community libraries
Quality of life indicator: Autonomy There is autonomy of the elderlies in doing what is pleasing for them and family responsibilities are not a hindrance in being autonomous	To continue with their having freedom and this is with planning for doing things that they desire	Coordinate with elderlies on things they want to do for themselves and their loved ones	Ask the seniors whether they are doing well in their autonomy
There is a need to help the elderlies as far as health matter is concerned.	To teach the elderlies to take care of their vascular diseases thru their medicines, their diet and lifestyles.	Thru their families and friends, the elderlies must be reminded to be aware of their maintenance meds, to be conscious of the food that they eat and the physical exercises that they do	Ask the family or the elderlies, how their health
Autonomy in financial matters is something to be reached	To be able to select important or urgent concern as far as money spending is concerned	Literacy on hierarchy of things to spend	Ask whether elderlies are happy in their selective buying Ask the elderlies how the financial concerns are helped with their adaptations and choosing

Finding	Objective	Activity	Learning Outcome
Quality of life indicator: Pleasure On pleasure, the elderlies are happy with their life because they see meanings in their life and they enjoy doing their usual things	To support the elderlies in doing meaningful and doing things they are most capable of.	Listening to elderlies on what are meaningful to them; their capabilities and abilities	To check on the elderlies if they continue to experience pleasure in their activities
Quality of life indicator: Self-reallization The elderlies have realized their dreams thru their children, they see their toils resulted in producing abled citizens. They feel full of energy and would continue to do for their grandchildren. They also feel doing things for themselves; studying perhaps, or having a personal business to add zest to their lives.	To help elderlies define their other desires for themselves or their families.	To listen to the elderlies talk about what are still their goals to achieve.	To ask the elderlies and /or their families what are the activities being done by the elderlies that are new or something they would like to do
Depression levels There is no depression felt by the elderlies	To keep this level of depression as much as possible	Giving PHQ-9 assessment test again	To determine from the seniors if they have any signs of depression
		Listening to the problems of the elderlies, watching their demeanors and interacting with the elderlies on how they overcome feelings of depression	To ask the elderlies how they or others are coping with life that ward off depression
		To share with the elderlies how others cope with life vicissitudes	

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The Effects of Training Workshop for Cognitively Intact Community Dwelling Older People on Knowledge of Dementia and Dementia Worry in Hong Kong

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Abstract

Background: Dementia is a global challenge. Little is known about the cognitively intact older people regarding their knowledge and worries about dementia. The aim of the current study is to assess the effects of training workshop to these group of people on the knowledge and their worries about this disease.

Methods: An interventional study with convenience sampling technique was conducted. Eligible older people who were residing in community and were cognitively intact were invited. A 3-hour workshop was given. Their knowledge was assessed by the Chinese version of the Alzheimer's Disease Knowledge Scale (ADKS). Their worries were assessed by the Modified Dementia Worries Scale (MDWS). Questionnaires were given to them before and after the training workshop.

Results: Among the 177 recruited subjects, 149 participants successfully completed the pre and post questionnaires. The score of ADKS was slightly above average before the training and most of the participants were not too worried about the disease. There was a significant increase in the ADKS and decrease in MDWS after the training.

Conclusions: The cognitively intact older people in the community demonstrated a very general knowledge on dementia with some knowledge deficits, they were not too worried about this disease. Training help to strengthen their knowledge and correct their misunderstandings. The result suggests more trainings should be provided to fill the knowledge gap. When more people have better understanding to this disease, it may lessen unnecessary worries and improve their quality of life.

Keywords: Community, Older People, Cognitively Intact, Dementia, Knowledge, Worry

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Introduction

Dementia is a progressive degenerative brain disease characterized by several symptoms that impair the cognitive, behavioral and physical functions. There are six common types of dementia, namely Alzheimer's disease (AD), vascular dementia, Lewy body dementia, fronto-temporal dementia, mixed dementia and dementia with reversible causes in which Alzheimer's disease is the most common cause of dementia, accounting for 60 to 80 percent of cases (Centers for Disease Control and Prevention (CDC, 2019). The early sign of dementia, just like forgetfulness is often overlooked, and till later stage, the demented client becomes more physically dependent with very significant memory loss.

According to World Health Organization (WHO, 2021), the number of people living with dementia worldwide is currently estimated at over 50 million in 2021 and will almost triple by the year 2050. There are nearly 10 million new cases annually. The total number of people with dementia is projected to reach 82 million in 2030 and 152 in 2050 (WHO, 2020).

All these figures are scaring as dementia does not only affect those suffering from this disease, it also poses great caring burden to their families and caregivers, they need to care for their personal and physical needs, as well as to manage their behavioural and psychological changes. Dementia also exerts great social and economic burden in global aspect. Its economic cost included direct costs, such as special nursing care, home healthcare, and long-term care, and indirect costs, such as quality of life and the impact on the caregiver. In 2015, the total global societal cost of dementia was estimated to be US$ 818 billion, equivalent to 1.1% of global gross domestic product (GDP) (WHO, 2021).

Despite the number of dementia is increasing globally, there are still a lot of myths regarding this disease. People often thinks dementia is similar to forgetfulness and is common in older people, also they thought brain cells are lost each day, and when people get old, the brain cells will run out ultimately (Dementia Australia, 2020). Some thinks that dementia only attacks older people, and it won't be fatal. All these are the myths about dementia and trigger unnecessary worries especially to the older generation.

Older people generated higher levels of fear of getting demented than any other disease, as dementia cannot be healed, and no medication can fully slow down the deterioration. Studies showed that the fear of getting dementia was as great as the fear of getting cancer. Data from different countries, such as England showed that two-thirds of the subjects over 50 years of old feared they would develop dementia compared with only 10% of fear of getting cancer. In France, 47 % of people over 60 years reported dementia was the disease that they most fear of. Thirty-one percent of Americans aged over 55 indicated that it was the disease they most fear of. Among aged 55 and above, they worried about getting dementia especially those with first degree relative with confirmed dementia (Cutler and Bragaru, 2015). Norman (2020) reported that for cognitively intact older people, nearly half of the participants reported that they were very concerned about getting dementia and approximately 16% reported being very concerned. Although majority of the studies showed older people worried about getting this disease, some studies showed only 29.4% of people expressed worry (Roberts, McLaughlin and Connell, 2014) and in the study by Horan, Jones, Pendleton (2007), 69% of the older people did not worry about getting demented. Williams, Tappen, Rosselli, Keane, Newlin (2010) indicated that participants with the experience of having demented relatives might increase their awareness and concern.

One of the reasons that older people worry about getting dementia was because of the lack of knowledge of this disease (Kim, Sargent-Cox and Anstrey, 2015). In Liu et al (2019), the knowledge score about dementia in China was only 63.14%, with only half of the participants could identify the risk factors correctly. Chinese people have low level of knowledge about dementia was mainly aged over 60 years old, with low education, live in rural areas and exposure to information on dementia. Scerri and Scerri (2017) reported that different educational programmes were organized for formal and informal caregivers but seldom emphasis on cognitively intact older people. Training of these group of people is important and may improve their knowledge of the disease. The study also showed that the introduction of such training programmes on dementia for older people may lead to healthier lifestyle behaviours, more help-seeking behaviours and is able to correct their misconceptions about this disease. Dementia is often scaring not only to people having the diagnosis, but also to older people who is still cognitively intact and physically healthy. The lack of correct concept and understanding resulted in stigmatization and barriers to diagnosis and care (WHO, 2020).

The picture of the number of dementia cases in Hong Kong is similar. The prevalence rates of dementia in Hong Kong is estimated to be at 5%-8% in older people aged over 65, and at 20%-30% among those aged over 80. Also, for people aged 60 and above, it is estimated to have around 333, 000 suffering from dementia and there will be 11% of people having dementia in 2039 (Yu, 2012). Lam et al (2019) had conducted a study on the perceptions of Chinese towards dementia in Hong Kong, the fear of dementia was found to increase with increasing age. Lack of knowledge is one of the main reasons. There is quite a few health educational programmes organized for healthcare workers, caregivers, domestic helpers about caring for dementia clients, however, for those cognitively sound older adults, they fear of having dementia and trigger a lot of worries, not many training programmes tailored made for them. If they do not equip with correct concepts and better understanding about this disease, unnecessary worries and fears will exist, as a result, the quality of life decreases, therefore early training and health education are of urgent needs. In view of this, it is worthwhile to explore the effects of training workshop to cognitively intact older people about their knowledge and worry of getting this disease, so that further implications may be tailormade for them to increase their dementia knowledge, alleviate their worries, improve their quality of life and lead a healthier lifestyle.

Materials And Methods

Research plan and methodology

This was an interventional study with convenience sampling technique. Eligible older people who were residing in community and were cognitively intact were invited.
A 3-hour workshop was given. The content of the workshop included:
-        Understand basic concept and stages of dementia.
-        The physical and psychological symptoms of dementia.
-        Care of dementia clients in activities of daily living.
-        Communication skills with demented clients.
-        Community support for demented clients and the caregivers.

Questionnaires regarding knowledge of dementia and dementia worry were given to them before and after the training workshop.

Sampling

Cognitive-intact community dwelling older people from community elderly centres of the non-governmental organizations were invited. The cognitive state of all potential participants was assessed by the Abbreviated Mental Test (AMT) for Chinese population. The inclusion criteria of the study were older people aged 65 or above, cognitively intact, with AMT score 6 or above, able to communicate in Cantonese, capable of providing informed consent. For those participants that had difficulties in reading, the investigator would help to administer the questionnaires.

Recruitment

The researcher contacted the directors and supervisors of the community centres, then visited those homes to ensure the venues were able to conduct the training workshop, also discussed with them the programme details.

Sample Size Calculation

Previous research indicated that a minimal sample size of 156 subjects were needed for the study of power 0.8, alpha 0.05, assuming small effect size of 0.2.

Procedure

Eligible subjects from the community centres were recruited and assessed. Initial screening assessment using AMT was done by the research assistant before the commencement of the workshop. A 3-hourly workshop was provided for the recruited subjects. The research assistant conducted the questionnaire within one week before the training workshop and within one week after the training workshop.

Data Collection and Instruments

The AMT was conducted during the recruitment period for assessment of the subjects' mental state. The questionnaire consisted of three parts. The first part of the questionnaire consisted of the demographic information; the second part was the Chinese version of the Alzheimer's Disease Knowledge Scale (ADKS) whereas the third part was the modified Dementia Worry Scale (MDWS). The Chinese version of the ADKS was used to assess the knowledge of the disease. The MDWS was used to assess the subjects' worries about dementia. Permissions were granted from the authors to use the above assessment tools.

Data analysis

IBM SPSS statistics for Windows, version 26 was used to analyze the data. Descriptive statistics, including the number and percentages were used to describe the socio-demographic characteristics of the participants. Mann-Whitney U Test and Kruskal-Wallis Test were used to test the relationship between demographic characteristics and knowledge of dementia in pre-test and post-test, as well as the relationship of the worry of dementia.

Statistical test was conducted to test the significance of the change of knowledge score. Shapiro-Wilk test was used to test for normality. Hypothesis of normality was rejected if p-

value was less than 0.05. Non-parametric Wilcoxon Signed Rank Test was used to test for significance.

It was hypothesized that the increase in knowledge of the disease minimized the worry of dementia. Simple linear regression was used to test for such hypothesis, with worry score in post-test as dependent variable and knowledge score in post-test as independent variable. The $R2$ value indicated how much of the total variation in the dependent variable, worry level, could be explained by the independent variable, knowledge score.

Ethical considerations

Ethics approval was obtained from the recruited elderly centres and the Ethics Committee of Caritas Institute of Higher Education prior to the study. Before the participants signed the consent form, all of them were fully informed of the purposes of the study, including the principles of recruitment and procedure of the study. The participants were informed that participation was strictly voluntary, and they might withdraw any time without any loss of benefits. The written consent form contained detailed information on the purpose and nature of the study, the right of confidentiality, and the right to withdraw.

Results

Participants' Characteristics

There were 197 older people showed interests in the training workshop, however, only 192 participants were included in the initial screening, as the AMT of five of them were under 6. Of the 192 participants, 177 attended the training workshop. However, 28 of them were further excluded because twenty-five questionnaires were found to have unmatched data and three of them were found to have age under 65 in the final check. Among the 149 successful data, majority of respondents were female (80.5%) and 19.5% were male. Most of them fell on age 65-70 (38.3%). Almost half of the subjects were married (47.1%) and completed secondary school (54.4%). One-fifth of them finished university studies (20.1%). Although 27 participants (18.1%) stated they got family members suffering from dementia, only 6 participants (4%) were taking care of demented family members at time of research. Six of the participants (4%) stated they had experience in caring demented family members.

Knowledge Score in Alzheimer's Disease Knowledge Scale (ADKS)

Before the training, the overall mean score of dementia knowledge was 19.42, (SD=2.67). The overall mean score was higher after the training and was 22.28, (SD=2.92). Twenty-four participants decreased in the knowledge score (16.11%), four remained unchanged (4.03%), whereas 119 participants showed an increase in knowledge after the training and corresponded to 79.87% of the total no. of participants (Table 1).

Table 1 Change of knowledge score after attending workshop

Change of knowledge score	No. of person	Percent	Difference (Post-test total score- Pre-test total score)	Frequency
Decrease	24	16.11%	-7	2
			-6	1
			-4	1
			-3	3
			-2	4
			-1	13
No Change	6	4.03%	0	6
Increase	119	79.87%	1	15
			2	18
			3	19
			4	21
			5	20
			6	10
			7	4
			8	9
			9	2
			11	1

Worry of Dementia in Modified Dementia Worries Scale (MDWS)

Before the training, the mean score was 19.7, (SD=8.71), whereas after the training, 81 (54.36%) participants showed a decrease in the level of worry. No change of worry in forty participants (26.85%) and 28 participants (18.79%) showed an increase in worrying about dementia after the training. Overall, there was a decrease in the score after the training and rated 17.52, (SD=7.11) (Table 2).

Table 2 Change of worry score after attending workshop

Change of worry score	No. of person	Percent	Change of score (Post-test - pre-test)	Frequency
Decrease	81	54.36%	-29	1
			-21	1
			-20	1
			-16	2
			-14	1
			-13	2
			-11	1
			-10	1
			-9	4
			-8	6
			-7	1
			-6	5
			-5	6
			-4	7
			-3	10
			-2	20
			-1	12
No change	40	26.85%	0	40
Increase	28	18.79%	1	7
			2	8
			3	5
			4	2
			5	1
			6	1
			8	1
			10	1
			11	1
			12	1

Relationship between knowledge and dementia worrying

To compare the relationship between the knowledge and the dementia worry, it was hypothesised that the increase in knowledge of the disease minimize the worry of dementia. Simple linear regression was used to test for such hypothesis, with worry score in post-test as dependent variable and knowledge score in post-test as independent variable. Hence only 0.4% of worry level could be explained by knowledge of dementia.

Relationship between demographic characteristics and knowledge of dementia

The performance of different age group in pre-test were similar. Nonetheless, after attending the workshop, the younger the participant was, the higher the knowledge score would be.

As for level of education, same trend could be identified in both pre-test and post-test. Moreover, the degree of improvement was more significant in those with higher level of education.

For marital status, it was noted before the training, the mean score of the knowledge of those separated/divorced was lower than those with other marital status. After the training, the null hypothesis was rejected and the knowledge of those separated/divorced group was improved.

It was observed that the worry level of those with family members with dementia and with history of caring for demented family members was significantly higher than those did not.

After the workshop, the worry level of participants with family member with dementia and history of caring demented family member was the same with those do not have family member with dementia and history of caring demented family member.

Discussion

The population is aging, and the number of dementia clients is increasing. Different trainings and workshops are conducted to caregivers, healthcare professionals on the knowledge and skills in caring for the demented clients. However, for those cognitive-intact older people, they are the group of people who may be neglected. The results showed that providing training with correct information to the cognitively intact older people significantly strengthen their concepts about dementia and a reduction in dementia worry.

The relationship between demographic characteristics and dementia knowledge

From the findings of this study, it revealed that demographic characteristics had great relationship to the knowledge of dementia and the effects of training also differed. There is statistically significant change of knowledge score after attending the workshop. Such findings contradicted to previous literature that training of Alzheimer's disease knowledge was not significantly correlated with any of the sociodemographic characteristics (Scerri & Scerri, 2017).

In many studies, age is one of the influencing factors that affected the understandings of dementia. In our study, the knowledge of different age groups in pre-test were similar, nonetheless, after attending the workshop, the younger the participant was, the higher the knowledge score. This finding was supported by few studies (Liu et al. 2019; Scerri & Scerri, 2017). In contrast, Carpenter et al. (2011), found that the knowledge scores tend to be higher with increasing age. In Hong Kong, the young-old group was still socially active and engaged in many community activities, they may not be interested to explore the knowledge of dementia, they may just hearsay or accept what is provided by social media. After the training workshop, correct information was provided, this might increase their awareness towards this disease and the score was higher.

Our study revealed an interesting finding. There was significant difference in the mean knowledge score of the ADKS among the marital status groups (p=0.04). The mean knowledge score of dementia for those separated/divorced groups were the lowest compare with those married or singled in the pre-training. Whether or not the trauma after divorce would linger and affect learning new things was in doubt and may be interesting to have further studies.

As for level of education, the mean knowledge score in ADKS for those subjects with university level had higher score (mean score 20.23) before the training when compared with those of informal school (mean score 17.44). The same trend was identified in the post-test.

The degree of improvement was more significant in those higher educational groups. This finding was consistent with previous studies (Liu et al., 2019; Scerri & Scerri, 2017). During the training session, those with higher educational level tend to be more attentive and were also more active in answering questions, they liked to ask questions when they were in doubt. Although improvement was shown in the informal school group immediately after the training, strategies should be made for this group to increase their interests and knowledge on dementia. Less educated older people might not have sufficient knowledge or resources to identify the early signs of dementia, they might think that dementia was just a matter of forgetfulness and tend to neglect the symptoms, and this phenomenon was not uncommon (Liu et al., 2019; Lynn et al., 2017). This group of older people posed great challenges in prevention of and treatment of dementia. Government and stakeholders should enhance the education, with medical and social support for this group of older people.

The effects of training on knowledge of dementia using Alzheimer's Disease Knowledge Scale (ADKS)

The ADKS contains 30 true/false items to assess knowledge about Alzheimer's Disease. One mark is given for each correct answer. The total score is 30.

Dementia often gives people the image that they would steal other people's things, had trouble in handling money, and increased risk of fall. These were reflected in question 14, 22 and 23. The overall score before and after the training were 90 or even higher. When Alzheimer's disease is not yet severe, over 95% of the participant agreed that psychotherapy may help to relieve their depression and anxiety. The high score reflected that generally, most people got a general picture of what dementia people would present with.

There were few questions that most of the participants answered wrongly, the score was low even after training. For question 2 and 16, the percentage of the participants that answered correctly were only 12.08% and 12.75% respectively. After the training, there were slight improvement with 36.24% and 13.42% respectively which were still below the average score. For question 2, they were asked "It has been scientifically proven that mental exercise can prevent a person from getting Alzheimer's disease". Since the cause of Alzheimer's disease is unknown, therefore, there is no certain way that this disease can be prevented. In the community, people are often encouraged to do more physical and mental exercises, to keep the brain active. This may only "reduce" the risk of getting demented, but all these strategies cannot prevent the occurrence of the disease. This is one of the common misconceptions that older people deeply rooted in their mind. In fact, numerous factors associated with overall good health may reduce the risk of dementia but cannot prevent its occurrence. (Alzheimer Society of Canada, 2022; WedMD, 2020). Accurate information regarding dementia should be given to the public. For question 16, most of the participants agreed that "once people have Alzheimer's disease, they are no longer capable of making informed decisions about their own care". In fact, people with dementia should not be assumed to have impaired capacity to make their own decision. It is important to educate the public that people with dementia should have their rights to decide what they like, and their autonomy should be respected (Hegde, S., & Ellajosyula, 2016). This misconception would create unnecessary fear towards this disease.

When asking about whether high cholesterol and high blood pressure may increase a person's risk of developing Alzheimer's disease in question 18 and 26, only 54.36% and 48.99% respectively of the participants answered correctly and agreed both are risk factors of having

dementia. After the training, the score of these two questions raised immediately to 83.22% and 81.88% respectively. The participants did not associate dementia with high blood pressure and high cholesterol and yet these are so common in older population. There is growing acceptance of a relationship between cardiovascular disease and Alzheimer disease and it was believed that brain function and blood pressure are deeply connected (Decarli, 2021; Power, et al., 2011). Older people are quite alert about their blood pressure and cholesterol, and some of the participants in the study might suffered from hypertension and/or hypercholesterolemia, when they were told in the training session that these two were the risk factors of getting dementia, they would increase their awareness as these factors are so closely related to their daily life and they tried to remember. This may explain why the difference of score was so great before and after the training. This also reflected the knowledge deficits. Proper health promotion as well as lifestyle modification should be reinforced. Another question that the score raised greatly after the training was question no. 6, 35.57% of the participants agreed that when people with Alzheimer's disease begin to have difficulty taking care of themselves, caregivers should take over right away. This may be explained by the traditional Chinese culture, the importance of filial piety and intergenerational solidarity. When the older people or the family members have difficulties in caring for themselves, the family members would assist them as much as possible. This was not correct to certain extent for people with dementia, they should be encouraged to do the tasks by themselves as much as they can, to train their brain function and respect them as an adult. This concept should be reinforced in future training.

The effects of training on dementia worries using Modified Dementia Worry Scale (MDWS)

The Modified Dementia Worry Scale is a 12-item measure of dementia-related anxiety. Participants rate how typical each statement is of them using a 5-point scale; The lowest score is 12 and the higher score is 60, higher scores indicate greater dementia-related anxiety. Among the 144 participants, 28 of them yielded 12 (18.8%) before the training and 38 (25.5%) after training. Only one participant scores 60 in the pre-test and 0 in the post-test. The result showed that these group of participants were not too worried about this disease. This result might not truly reflect the situation of the older population in Hong Kong, because for those participated in this study, they were members in the community centres, they were comparatively more active and had their social lives, they might have less worries or they might seek help from their peers. In such case, training might not lessen their worries of getting dementia and only 0.4% of worry level can be explained by knowledge of dementia. However, there were 27 participants had family member with dementia and six of them were currently taking care of their demented family members. Six of them had history of caring demented family members, it is observed that the worry level of those with family members with dementia and with history of caring for demented family members was significantly higher than those do not. With the proper knowledge given in the training workshop, it is noted that after the workshop, the worry level of participants with family member with dementia and history of caring demented family member became the same with those do not have family member with dementia and history of caring demented family member. This indicated if people had better understand of dementia, it might lessen their worries.

Limitations

The findings of the study supported the hypothesis that training may increase the knowledge of dementia of the community dwelling older people and may lessen their dementia worries;

however, one limitation of this study is the small sample size. With the increasing trend of the proportion of elderly aged 65 and over, the number of participants in the current study was difficult to generalize the findings to the older people in Hong Kong. The participants recruited were mainly from community centres, whereas those older people who need to take care of their demented family members might not be able to attend the training workshop, thus the dementia worries might not be truly reflected in the study.

Another limitation was that the training workshop was only one-off and lasted for three hours. Though the content was comprehensive, it might not fully cover all the important information about dementia. The participants showed interests in the topic, however, the concentration span of older people might not allow them to be very attentive even some games and exercises were built-in in the workshop. Sustainability of what they have learnt is also in doubt. In future, shorter duration with few more sections would be more beneficial to them.

Lastly, the instrument was adopted from western countries. Although it was being translated into Chinese and being validated. Some items might not be associated with their daily living and were not too culturally related, such as asking if demented older people were safe to drive the car. Driving in Hong Kong is not as common as western countries for older people. When asked about dementia worries, some older people found to have difficulties in understanding some of the items, the researcher need time to explain clearly to them. The older people also tend to share lots of their own feelings and experiences but not specifically answering what was being asked. A qualitative way or a mixed method of study might be more informative in the future.

Conclusions

This study highlighted the importance of training to the cognitive intact community dwelling older people about dementia. Apart from teaching the caring technique, correct knowledge is equally important especially to fill the knowledge gap and to alleviate unnecessary worries. The findings were able to identify knowledge deficits and worries in some specific groups of older people in the community. It is important to provide the real facts of dementia and stop the myths. In the long run, emphasis should put on those cognitive intact older people who need to take care of their family members at home and not able to attend onsite seminars or lectures to increase their knowledge. When more people in the community have better understanding to this disease, it will improve the quality of life of older people with or without dementia.

Acknowledgements

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Improving Resilience in the Elderly Through Robot-Assisted Dementia Therapy

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Abstract

The number of older people with dementia has been steadily increasing for years. Physical and mental fitness is a supporting pillar for increasing resilience with regard to dementia. Therefore, older people should perform exercises as often as possible and in a targeted manner to prevent and treat dementia. Due to high cost pressures and staff shortages, there are limited caregivers available to supervise these exercises. Therefore, it is necessary to explore a dementia robot that can be used by elderly people to perform dementia therapy exercises alone at home, without a rigid schedule. In consultation with caregivers, ball games, high-five games, and strength exercises were identified as realistic exercises. The robot should include an adaptive interaction system that controls the design and sequence of the exercises in such a way that the patient receives the best possible individual support. For the realization of this knowledge-based system, initial parts of the nursing staff's expertise were acquired and formalized in five nursing facilities. Based on this, a metric was derived which, after a classification of the patient's daily performance, allows an appropriate adjustment of the degree of difficulty of the exercises. The formalization of knowledge will now be discussed, verified, and detailed with nursing experts from science and practice. After completion of this knowledge acquisition, the interaction system will be implemented and prototypically transferred to a mobile robot. Subsequently, the dementia robot will be evaluated in a test person study with regard to its performance and its acceptance.

Keywords: Resilience, Robotic, Dementia, Fuzzy Logic, HMI

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Introduction

The UN's 2019 world population forecast predicts a drastic increase in the number of people over 65 in the coming years (United Nations, 2019). The fact that demographic change is also steadily increasing the number of seniors living in nursing homes can already be observed and will continue to increase in the next years (Graf, 2018). Physical and mental fitness is very important for building resilience to dementia. The prevention and treatment of dementia in the elderly therefore requires time-intensive care by nurses, which must be tailored to the health of the individual. In order to provide the best possible care for nursing home residents, certain standards of care must be met. These include specific care and nursing for age-related conditions such as dementia, assuming an adequate number of employed nursing staff with competent expertise (Korecic, 2013). Maintaining adequate quality of care will be an enormous challenge for the nursing sector in the future, as currently staff is being reduced wherever possible due to cost pressures in nursing homes (Graf, 2018). In addition, the COVID-19 pandemic has created additional challenges for the nursing sector due to hygiene regulations.

For these reasons, intensive research has been conducted for several years on how to reduce the workload of caregivers through the use of care robots and how robots can be used to promote the mental and physical development of older people. The acceptance of robots by the elderly depends not only on the performance of the robots, but also to a large extent on their ability to interact. For this reason, numerous research projects on the topic of care robots have been conducted in recent years and a large number of findings have been obtained. Within the research, dementia stands out as a special application area that places high demands on caregivers and for which there is not yet adequate support in the form of high-performance care robots.

The care of dementia patients is very complex and requires elaborate and time-intensive care. Due to the high incidence of dementia in nursing homes, care measures are already very much focused on the therapy and prevention of the clinical picture (Radenbach, 2017). Current care robots for dementia patients mainly provide supportive functions in the area of loneliness prevention and entertainment, but not for therapies with haptic exercises that are regularly performed by caregivers alone with dementia patients (Chang et al., 2013). This results in an urgent need and a high potential use for a caregiver robot that supports dementia care with appropriate haptic exercises. Ball throwing, high-five games, and strength exercises have been identified as haptic exercises that can be performed by an autonomous mobile robot given the current state of the art. Such a dementia robot relieves the burden on caregivers, as patients can practice independently with the robot. For patients, the dementia robot offers the advantage of being able to exercise flexibly and without a rigid schedule, both in the nursing home and individually at home.

The usefulness and acceptance of such a dementia robot depends largely on its ability to interact. Therefore, the long-term goal of the research presented here is to develop a knowledge-based interaction system for a dementia robot that adaptively optimizes the robot to the patient's current performance ability and therapy goal in the aforementioned haptic applications. The interaction system is intended to utilize the specific expertise and many years of practical experience of the nursing staff. Therefore, for the realization of the interaction system, it is necessary to collect the expert knowledge of the nursing staff through knowledge acquisition and then formalize it in order to be able to integrate it into a knowledge-based system. Therefore, the research question of this thesis is: In which tasks of

dementia therapy can a current nursing robot support the nursing staff and which information-based interaction concepts are necessary for this purpose?

Related Work

In order to answer the research question specifically, a broad understanding of the scientific basis and prior work on dementia care, dementia robots, and knowledge acquisition in the medical field is required. Therefore, the current state of research in the literature is summarized and evaluated below.

Dementia Care Terms

Activities of Daily Living is an indicator used to assess a person's ability to care for themselves. There is a significant correlation between the cognitive fluctuations of affected dementia patients with the decrease of the ADL indicator (Edemekong et al., 2017). There are a variety of promising therapeutic methods for the prevention and treatment of dementia in nursing homes. Gesundheit in Bewegung 2.0, (GiB 2.0), is a research and development project of the Kärnten University of Applied Sciences, based on a systematic compilation of international scientific results. The scientific evaluation of the program shows a significant effect on the mobility of the test persons in the area of social and communication behavior as well as on activities in everyday life (Gebhard & Schmid, 2017). In addition to GiB 2.0, another non-pharmacological treatment exists for people with dementia. MAKS is a multi-component therapy consisting of a motor, everyday practical, cognitive and social module (Gräßl, 2019). The results of a cluster randomized controlled, single-blind study over six months regarding the success of a MAKS therapy show that, on average, the outcome measures "cognitive abilities", "practical abilities" and "practical daily living skills" stabilized (Straubmeier et al., 2017).

Robotic in Dementia Care

Robotics is advancing rapidly in the medical field. Driven by technical progress in sensor technology, there are now various forms of interaction between humans and robots. A basic distinction can be made between three forms (Bendel, 2018). In nursing robotics, human-robot collaboration is predominantly used, in which the human works directly with the robot. For this purpose, safety standards are defined in the form of a precise definition of the workspaces. The intersection of the robot's workspace and the worker's workspace is the shared workspace (Thiemermann, 2004). Mostly, autonomous mobile robots are used that take over tasks independently and execute them fault-tolerantly. To do this, they use a range of skills which they can apply in a targeted manner when carrying out tasks (Hertzberg, Lingemann & Nüchter, 2012).

Looking at the operating concepts of existing care robots in dementia care, different interaction classes with individual benefits and deficits emerge. A basic distinction is made between natural user interfaces and computer interfaces. In general, well-known dementia robots such as Paro, Pepper, Mario and Nao offer the common Natural User Interfaces speech, facial expressions, gestures, biosignals and haptics, which can occur in different combinations (Bendel, 2018) (Chang et al., 2013) (Sather et al., 2021) (Mannion, 2020). Sensors and screens are used as the basic computer interfaces. The exact form of the respective interaction class varies depending on the specific use and application of the robot. Overall, however, no fine-grained concepts for situationally appropriate haptic use in

dementia care can be observed in existing care robots. The research focuses on the realization of applications with simple haptic feedback to patients without the targeted use of specific expert knowledge. However, for efficient operation, an application-specific, User Center Design is absolutely necessary (Schweiger, 2018).

Transferable Therapy Exercises

Science-based non-medicinal dementia therapies such as MAKS and GiB 2.0 ensure health gains as long as human caregivers use them. Because some activities are very community-based and often involve highly unpredictable processes, certain therapy exercises are currently more transferable to a robot than others. Training concepts in which nursing home residents exercise motor skills, cognition, coordination and strength not only achieve health benefits, but can be very well realized by robots. Pushing and pulling are important exercises for successful therapy. Elastic bands are often used for this purpose. Instead of the bands, the robot can be used as a training partner. Essential interaction concepts of care robots are haptics, gestures, speech and facial expressions. Overall, the three categories of ball games, coordination exercises and strength exercises are very well suited for transfer to a care robot (Schweiger, 2021).

Figure 1 shows how the exercises can be performed with a dementia robot instead of a caregiver as a partner. In the ball throwing game, the dementia patient has to catch a ball that is thrown to him by the robot. In the high-five game, the dementia robot claps the hands of the dementia patient with a musical background. In the strength exercise, the patient pushes or pulls on the robot arm.
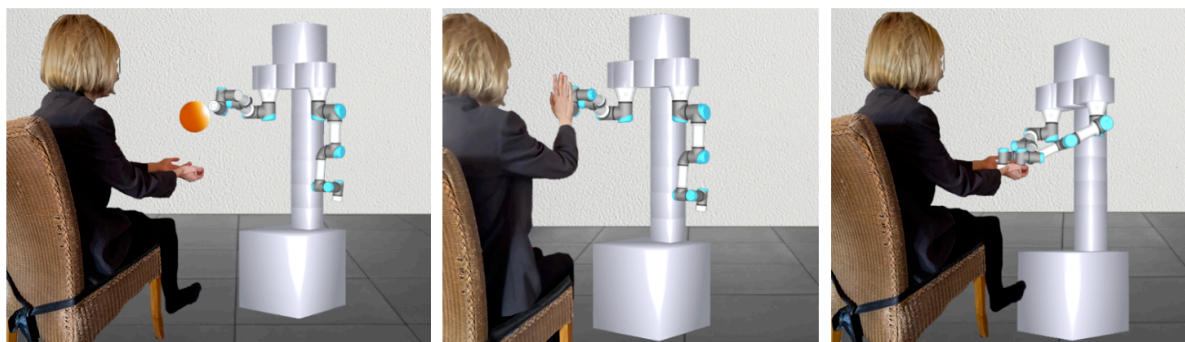

Figure 1: Exercises Dementia Robot

Summary

Currently, however, there is no dementia robot that can perform haptic therapy exercises such as ball games, coordination games and strength exercises together with the patient. Consequently, there is no knowledge-based interaction system that uses the knowledge of the caregivers specifically for these exercises. Furthermore, there is no scientific research so far on which knowledge is used in detail for the mentioned exercises and how to formalize it with regard to a knowledge-based interaction system for a dementia robot. Finally, there has not yet been a study that uses user-centered design to evaluate an appropriate interaction system together with caregivers and patients.

Method

To realize a knowledge-based interaction system for a dementia robot, the specific expertise of caregivers on the mentioned exercises ball throwing, high-five games and strength exercises has to be acquired. The knowledge acquisition is done in two steps, the Knowledge Collection and the Knowledge Modeling. The resulting interaction classes form the basis for building a knowledge-based planning system that plans in real time the actions of the dementia robot during the execution of one of these exercises and passes them on to the actuator for execution.

Knowledge Collection

For knowledge acquisition, on the one hand, the relevant methods of knowledge acquisition for expert systems must be used. Since this is a knowledge-based interaction system, appropriate user experience design methods are also used. So far, expert knowledge has been collected in a total of five regional nursing homes using the methods of Contextual Inquiry and expert interviews. The focus was primarily to capture the small but typical tricks that caregivers use with impaired patients to achieve successful therapeutic progress.

Expert Interviews. First, interviews were conducted. The survey method expert interview belongs to the qualitative methods of social research and is a special form of the guided interview (Blöbaum et al., 2016). For this interview, five experts with in-depth knowledge of dementia care from five different nursing homes in the Regensburg area were recruited and interviewed for one hour. The interview guide was created using the SPSS method (Helfferich, 2014). The expertise that was identified included especially the partly fine granular changes in the difficulty level of the exercises, in order to achieve therapeutic success as effectively as possible. The method captured a broad body of knowledge that was first documented and evaluated and then formalized into concrete interaction classes and heuristics.

Contextual Inquiries. After the interviews, an initial observation was conducted in the natural context of application through the Contextual Inquiry method. The three-hour observation of caregivers performing dementia exercises provided a realistic assessment of the actual interactions between patient and caregiver. An additional post discussion with the competent nurse could concretize unclear procedures in the specific handling of a person suffering from dementia during the exercises. The evaluation of the qualitative data from contextual inquiries and interviews was based on empirical methods. To this end, Bryman's four stages of qualitative analysis were used to identify correlations and orders of factors of particular relevance (Hinrichs et al., 2017).

Knowledge Modeling

The knowledge collected about each nurse is hardly characterized by precise measurements of specific patient responses and actions. Instead, patients are summarily assigned characteristics as a consequence of their behavior, which describe their performance in natural language. These terms also play a central role in both the caregivers' classification of the degree of dementia and the adaptation of exercise design. Therefore, it is necessary to capture these terms in the course of a knowledge acquisition and to represent their meaning. Fuzzy logic is already used to describe medical contexts (Ozsahin, 2020). Downstream neural networks can be used to realize classifiers that are capable of learning (Gayathri, 2018).

Therefore, Fuzzy Logic is used as a description method for describing the expert knowledge in the form of a taxonomy. In particular, for each term mentioned, a linguistic variable is defined to which different linguistic values can be assigned. Each linguistic value is thereby described by a membership function, which describes both the underlying, sharp physical size, and their fuzziness. The fuzziness here arises predominantly from knowledge elicitation with different caregivers. From the natural language assessment of patient behavior, nurses assign each patient a natural language dementia level and an individualized exercise routine. Applied to knowledge acquisition, this means that the linguistic variables describing the patient's behavior are assigned a linguistic value for the degree of dementia and the robot's follow-up responses. The mapping is thereby specified as fuzzy rules.

Results

Interaction System

The results show that the execution of the identified dementia therapies in the form of group therapies is a compromise for all participants. Since the health status of a dementia patient can vary greatly and even fluctuate depending on the day, group therapy often over- and underchallenges patients and is only just right for a fraction of patients at that moment. The fun factor suffers as a result, and health promotion is not optimized in the process. Caregivers therefore often conduct additional individual therapies, which are, however, very time-consuming. The usefulness of the robot with a knowledge-based interaction system, with which the patient can practice independently and individually, is underlined by this aspect. Overall, it was possible to gather extensive expert knowledge on how to deal with dementia patients with different levels of performance during dementia therapies.

Knowledge Modeling. The knowledge of the nursing staff for the implementation of these exercises in the context of dementia therapies consists, on the one hand of professional school knowledge acquired in the context of specific training. On the other hand, the nursing staff also have a broad wealth of experience for the individual implementation of dementia therapies. In order to be able to develop a knowledge-based interaction system for a dementia robot, this expert knowledge of the caregiver must be transferred to the robot. For this purpose, a taxonomy with heuristics serves as a basis in which this knowledge is modeled in a fine-granular way. The expert knowledge is structured into seven levels in the taxonomy. The upper levels specify the therapy framework with the three identified dementia exercises and the exercise goals. Each specific exercise improves targeted disease-related limitations through specific manipulated variables. The lower levels of the taxonomy map the specific variation variables and variation values. Figure 2 shows a section of the four lowest levels. Building on this factual knowledge, caregivers have a variety of tips and tricks on how to vary the individual variables between exercises to gradually adjust the level of difficulty with respect to the therapy goal. This knowledge has been modeled in the form of rules. For example, one of these rules is shown in Figure 3.
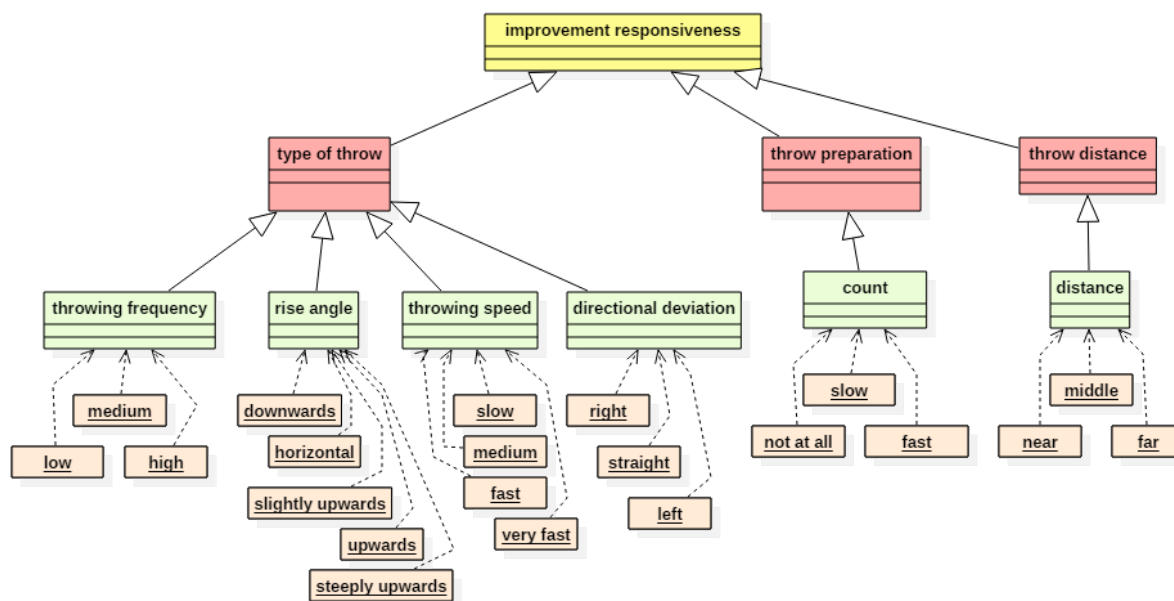
Figure 2: Part of ball throwing taxonomy nurse

Knowledge Formalization. In order to be able to transfer this knowledge to the dementia robot, fuzzy logic was selected as the form of representation for the expert knowledge. This made it possible to formalize summary, natural language descriptions of facts and actions in the form of fuzzy sets and fuzzy rules. This formal specification of expert knowledge can then be evaluated with an adaptive, optimizing real-time planning system. The actions of the plan consist of the associated robot capabilities, which are adjusted to the respective difficulty level of the exercise using the expert knowledge.

Here is an example: to improve the patient's reaction time when throwing a ball, different variation values can be selected to change the difficulty level of the exercise. The variation values of the rise angle, the direction deviation and the throwing speed. In the same way, the degree of dementia is specified as membership functions (see figure 4). The fuzzy rules shown in figure 5 define on the one hand how the concrete values are varied between exercises and thus the adapted behavior of the robot. So, if the patient manages to catch the ball when the directional deviation was performed straight, the rise angle was chosen upwards and the throwing speed was slow, the directional deviation should be set to the right for the next throw to increase the difficulty. On the other hand, the rules also determine the classification of the patient's dementia exercise level. For example, if the rise angle was laid out horizontally, the directional deviation was set to the left, the throwing speed was performed quickly, and the patient was able to catch the ball, then the dementia exercise level in this rule example is classified as "no dementia".

If the patient can safely catch a ball thrown slowly, directly to him, upwards, then in the next exercise I throw the ball slightly to the side.
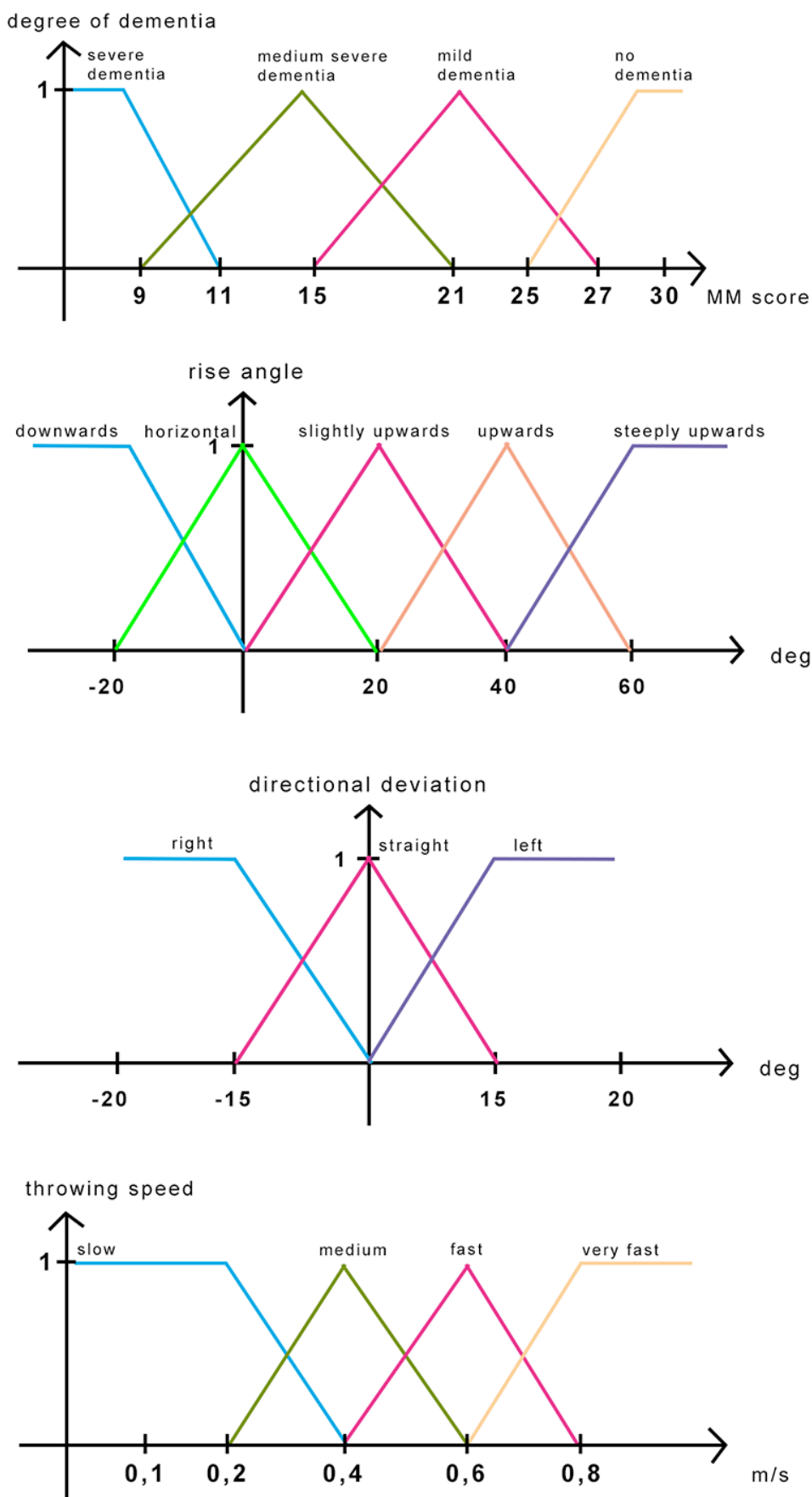
Figure 3: Exercise variation rule

Figure 4: Example membership function

```
if       (directional deviation = straight AND
         rise angle = upwards AND
         throwing speed =  slow AND … AND
         reaction = caught
then     directional deviation = right


if       (rise angle = horizontal AND
         directional deviation = left AND
         throwing speed = fast AND … AND
         reaction = caught)

then     degree of dementia = no dementia


if       (rise angle = upwards AND
         directional deviation = straight AND
         throwing speed = slow AND … AND
         reaction = touched)

then     degree of dementia = mild dementia
```

Figure 5: Example fuzzy rules

Discussion

The results of the knowledge acquisition show that the nurse's expertise for the exercises is multi-layered and finely granular. The experiential knowledge is largely case-based and is also applied on a case-by-case basis with the help of analogy building. Classification is exercise-based using indicators that are dynamically summarized into a dementia grade. The case-based knowledge is largely applied summarily. In the foreground of the exercises is always the enjoyment of the exercises and only then the success of the therapy. The expert knowledge therefore contains a lot of room for interpretation in the assessment of the patient's current performance. In addition, it contains numerous, fine-grained variation possibilities for the design of the next exercise in each case. Finally, the procedures are not universally applicable, because successful empirical values for one patient do not always lead to the same success for other patients.

Therefore, the interaction system of the dementia robot must be designed in a particularly adaptive way and be able to optimize itself depending on the situation. Therefore, it was important to design the knowledge model in such a way that both the summary classification of the patient and the flexibility of the actions based on it are represented. The specification form with fuzzy logic used for this purpose proved to be suitable. By using the expert knowledge of the caregiver, the dementia robot can act purposefully in a situation-specific context. Compared to other dementia robots, the concept is thus much more specific and concrete. In particular, the robot can not only perform common interactions with Natural User Interfaces and computer interfaces but can also implement the little tricks of a caregiver and interact haptically. This is an added value compared to previous dementia robots, which are also very much designed for specific mental domains such as loneliness.

Limitations

The taxonomy of knowledge acquisition documents so far only the first results from knowledge acquisition. So far, these have also been transferred to fuzzy logic with only a few case studies. In order to be able to explore the detailed expertise of the experts in a fine-

granular way, further observations and formalizations must be carried out. Moreover, only the nurses' point of view has been considered so up to now. The patients' assessment of the effectiveness of the exercises has not yet been included. Further methods from user experience design must be used for this purpose.

Conclusion

From the results, it appears that the realization of a caregiver robot to perform the identified therapies of ball games, high-five games, and strength exercises is entirely feasible based on the current state of research. The construction of a taxonomy for modeling the factual knowledge of the nursing staff has proven to be successful. Rule-based description to classify dementia level and variation of actions is appropriate. Formalizing the knowledge using fuzzy logic is possible and provides a good knowledge base for the real-time adaptive planning system.

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Revitalising Urban Spaces to the Needs of the Aging Population - Biophilic Healing Index Supporting Active Aging in Inclusive Cities

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The European Conference on Aging & Gerontology 2022
Official Conference Proceedings

Abstract

Due to recent years' involvement in research on behaviours of vulnerable aging people, the author had the opportunity to explore ideas about places and spaces for carers and members of their families living with the condition of dementia by exploring and analysing case studies of interactive spaces in creative neighbourhoods. Investigation of the performance of public open spaces, including streets, piazzas, green and blue infrastructure led to understanding how the built environment and urban space can impact changes in the mood and behaviours of people suffering from mental illnesses and conditions. Hence, the author shared research with students by focusing on the human behaviours of people navigating in urban spaces designed for active aging and human comfort. Students and the tutor have measured Biophilia in urban spaces and promoted the implementation of spatial configurations of human movements via permeable pathlines that increase walkability and free flow. Cognitive patterns of active connectivity have been designed in spaces where navigation of people with mental health conditions should be able to move freely, relax and enjoy the outdoors. Patterns have been carefully selected and discussed with other authors and researchers, such as Nikos Salingaros who has been promoting Biophilic Healing Index (BHI) measurements for a better quality of life for all for several decades. BHI concepts promote free fractal flow that integrates indoors and outdoors in harmonious ways. BHI is being tested as a validated tool to help practitioners and planners to design age-friendly cities, and support communities to recover from recent restrictions.

Keywords: Biophilic Healing Index, Active Aging, Inclusive Cities, Urban Space Revitalisation

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Introduction

This paper describes how the tutor and her students have used recent findings from surveys that were carried out in an area near the university campus at the University of Derby in the UK. This area expands and blends with the university campus and it is filled mainly with housing inhabited by approximately 70% of an aging population, some of them still active at work or in pension. The surveys were carried out during the academic year 2021-2022 under the supervision of the tutor who provided information to the students about biophilic design and especially about the Biophilic Healing Index. The outcome of these surveys gave the students the opportunity to measure existing patterns of biophilia, if any present, and to try to understand where they should be able to suggest changes to achieve higher scores/percentages of certain patterns via innovative ideas included in their projects for the module Project Research and Urban Design in their programme of studies, BA (Hons) Interior Architecture and Venue Design.

For several years, the author had engaged in shared research with other colleagues at the same university during which she came across and got involved with organisations and institutions that were caring out important projects to improve the health and wellbeing of vulnerable aging groups of social housing residents in the care of persons of their own family environment or local volunteers and social workers. The author of this paper presented her findings at a few national and international conferences in recent years (Tracada, 2017) Hence, she shared her findings with her undergraduate and postgraduate students in her lectures and specialist workshops by also inviting important international scholars to participate in them. As the author has been always interested in the livability of cities, she instructed her students to follow principles and practices aiming at making cities livable, sustainable, and resilient; she also introduced her students to UN Sustainable Development Goals (SDGs). The students had to apply theories and practices of biophilia in their projects, and, at the same time, they had to prioritise and showcase a series of urban space interventions so that health and wellbeing should be at the top of their intentions.

The tutor has also taught her students about special international policy papers, such as *Unfolding Dilemmas of Urban Public Spaces* (Ersoy & Yeoman, 2019) which was published by JPI Urban Europe's Agora. This publication contains important case studies, and amongst them, we found important solutions to the reconfiguration of public spaces via nature-based solutions ensuring inclusivity and accessibility for all citizens. According to JPI Urban Europe's Agora, citizens should be actively involved in the planning and design of public spaces, and local scholars and Universities should be in support of their efforts, too.

To summarise our efforts, we shall show you how by using the Biophilic Healing Index, we managed to test and reconfigure spaces and places for all. The main objectives were:

- Research findings were shared by the tutor and students with representatives of the local communities during forums and surveys; the students and the tutor focused on the human behaviours of people navigating in urban spaces designed for active aging and human comfort. Students and tutor have measured Biophilia in urban spaces and promoted the implementation of spatial configurations of human movements via permeable pathlines that increase walkability and free flow.
- Cognitive patterns of active connectivity have been designed in spaces where people with mental health conditions should be able to navigate, move freely, relax and enjoy the outdoors (also connected with comfortably accessible indoors).

- Patterns have been carefully selected and discussed with other authors and researchers, such as Professor Nikos Salingaros who has been promoting Biophilic Healing Index (BHI) measurements for a better quality of life for all for several decades.
- BHI concepts should be the main promoters of free fractal flow that integrates indoors and outdoors in harmonious ways to support all ages and backgrounds.
- BHI is being tested as a validated tool to help practitioners and planners to design age-friendly cities, and support communities to recover from recent restrictions.

The author believes that the principles of biophilia applied to the built environment and the green and blue infrastructure have the power to always change human behaviours. So, we should be able to transform cities easily to become livable and resilient. As livability relates directly to urban design and planning, both social mobility and financial prosperity could be also altered and affected to the best of a planner and a biophilic designer's intentions (Tracada, 2018). The author has always sustained that all livable neighbourhoods should be *"compact, sustainable, diverse, green, healthy, and above all resilient"* (Tracada, 2022) This is the reason why as a tutor, she promoted the implementation of Sustainable Development Goals; that means participatory planning and engagement of local communities could easily transform cities to be accessible now and in the future. Citizens and scholars should always get involved in active decisions of policymaking.

There is a strong long-lasting legacy of the author with international scholars, and especially with the International Society of Biourbanism (ISB); all scholars of this society have based their research on human-centred design, especially on Biophilic Urban Design. Biourbanism's main aim is *"making a healthy city for healthy citizens"* (Caperna, Tracada & Serafini, 2013). So, also the students learned:

How human neurophysiology reacts to the organization and the forms of space, is the first step to producing an undeniably sustainable new design for the 21st century (Caperna, Tracada & Serafini, 2013).

The author's legacy with Nikos Salingaros began with her involvement in the International Society of Biourbanism as a member of the Scientific Committee at first and being an Editor in Chief for the Journal of Biourbanism from 2011 to 2014. Salingaros's theories on urban science, and especially his principles of the urban web blended with the author's theories on the Line Performance Act thesis and consequent presentations. Hence, Salingaros (1998 & 2005) discussed with the author of this paper the way that humans connect amongst them. Salingaros affirmed that all humans can connect not only visually, but also via less obvious connections (Salingaros, 1998 & 2005). Both scholars agree that the human mind establishes a deep connection with any kind of environment by possessing geometrical information from its surroundings. Thus, some angular and pointing forms, as well as grid-iron plans of indoor or outdoor spaces may create more anxiety for vulnerable people, especially the elderly affected by mental health issues, such as people with dementia condition.

So, during a lecture that Salingaros offered to our students in February 2021, he repeated that the main aim of effective and high-quality design projects should be to explore form, components, and substructure to justify theoretical underpinning based upon urban science and theories; to justify that *"a living city depends on an enormous number of paths and connections of people."* (Salingaros, 1998 & 2005, 2019 & 2020) Both Nikos Salingaros and the author have taught the students how they should be able to use the Biophilic Healing Index to measure percentages of existing or non-existing patterns (0%) (Salingaros 2019 &

2020) that means that all designers should be able to carry out computing of the Biophilic Healing Index (BHI); Salingaros agreed to propose the following as the main handout for the students as shown in Figure 1. By using this main table of patterns, the students should be also able to create appropriate questions to ask the users of the spaces under investigation and revitalisation, and possibly give a score from 0 to 2 per each pattern. In the case of spaces and places used by vulnerable elderly, their carers and/or family members could do an estimate.

Nikos A. Salingaros at our annual guest lecture for our students on 22nd February 2021:

"We can quantify Biophilia through the Biophilic Healing Index. This gives a percentage score evaluation of how biophilic a design actually is, which combines estimates for ten separate biophilic qualities. "

Estimate ten geometrical plus natural qualities listed below according to the scale: 0 = none, 1 = some, 2 = a lot:

B1. Sunlight: preferably from several directions.

B2. Colour: variety and combinations of hues.

B3. Gravity: balance and equilibrium about the vertical axis.

B4. Fractals: things occurring on nested scales.

B5. Curves: on small, medium, and large scales.

B6. Detail: meant to attract the eye.

B7. Water: to be both heard and seen.

B8. Life: living plants, animals, and other people.

B9. Representations-of-nature: naturalistic ornament, realistic paintings, reliefs, and figurative sculptures — including face-like structures.

B10. Organized-complexity: intricate yet coherent designs — and extends to symmetries of abstract face-like structures.

Sum the values for the above biophilic components to define the index B as a number out of 20. For B as a percentage score, simply multiply this total by 5. A quantitative measure of the degree that a design is biophilic is more useful than the usual vague discussions based on images showing potted plants. The more biophilic it measures on this scale, the more a building will contribute positively to the users' health." **WE ARE USING THE INDEX FOR STREETSCAPES AND PIAZZAS & BUILDINGS (INDOORS & OUTDOORS).**

Figure 1: The Biophilic Healing Index as agreed by Nikos Salingaros and the author for the Annual Lecture in February 2021

Measuring Biophilia, and checking indoors and outdoors affordances

In their projects for the module of Project Research and Urban Design in 2021 and 2022, the students were also allowed to start using more than the ten patterns prescribed in Figure 1 above. The reason for this was that initially, they had to explore some suburban areas of the City of Derby in which we had carried out surveys a previous couple of years, and we found a lot of problems with accessibility and mobility in the urban spaces for people with mental health issues (a high percentage of elderly people in need of social care). As the area of interest in 2021 and 2022 has been our campus and the city, then, the students focused on patterns that were easily detected by residents of the areas of interest.

So, the top patterns to explore and get answers to specific questions have been:

• Visual connection with Nature, such as connections with vegetation, animals and insects, natural flowing body of water

- Non-visual connection that deals with ventilation, tactile information such as textured materials, and fragrant plants' smells.
- Presence of water, such as brooks, ponds, fountains, and waterfalls.
- Thermal comfort that deals with solar heat gain, shadow, and shade, radiant surface materials.

The following is an example of a table created by one of the students to check the health and wellbeing of citizens, and to measure BHI in streetscapes in an area that surrounds a green park (See Figure 2). The table does not show percentages for the patterns selected; it shows only scoring from 0 (absence) to 2 (high presence).

Attribute	Level of Presence	Notes
Presence of Biodiversity	2	Trees, varied shrubbery, forbs and grass present
Presence of Organised Complexity	2	Inherent organised complexity of the diverse planting incorporated, details of bordering and spatial organisation of beds
Presence of Fractal Geometry	1	Presence of trees (both within spaces and linearly lining the circulation spaces), geomtry of planting beds used to incorporate scales of geometry into green spaces
Presence of Vegetation	2	Varied and diverse planting
Presence of Animals or Fossils	1	Birds (viable and audible) and insects
Preferred Views & Vistas (Savana Analogue)	1	Grass combined with shrubbery and trees, however no water, and some trees are isolated rather than copses and proliferation of hard landscape bisecting spaces mitigated the presence
Representations of Nature	0	None present
Presence of Curves	0	None present
Presence of Water	0	None present
Coherent Combinations and Variety of Colour	2	Plants of varying hues, both between plants and withing individual plants, most paving with earth tones and hues with varying intensity of hues within it
Opportunity for Sustained Visual Connection	2	Looked upon by communal spaces of new and refurbished blocks of flats, located adjacent to main circulation spaces

Table 4.6: Analysis of biophilic attributes of public space green corridor.

Figure 2: Sample of student survey by using BHI patterns

Here are some samples of proposed solutions by the students who had discussions with residents at the Arboretum ward in Derby in 2020-2021. Figures 3 – 5 show the transformation of a disused car park area in front of a primary school entrance; the car park used to be the school courtyard. But being close to the Arboretum Park area meant that this courtyard was becoming an area for criminality during the night. The Park started being transformed slowly after the end of Covid-19 restrictions, but at night it was known for criminal activities. The courtyard is reached by an alley on one side of the school. It lacked light at night, and it was dark during the day, too, due to its dark tarmacked surface. The team of students measured the BHI of that space; it scored only 15% for biophilia. With the proposed scheme presented to the local community, the BHI reached 85-90% of biophilia.

Figure 3: The *Secret Garden*

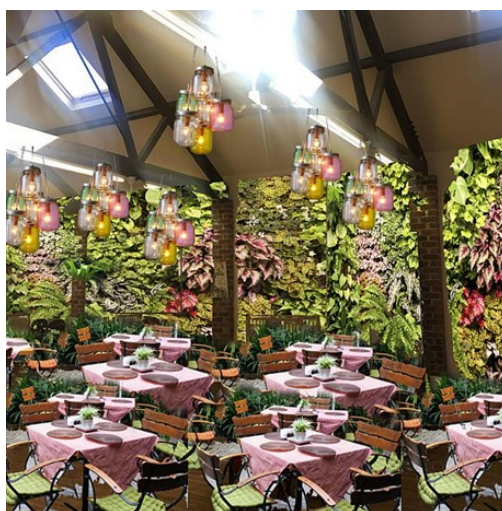Figure 4: The *Back Alley to the Secret Garden* at Arboretum

Figure 5: Indoor Outdoor Café at the Secret Garden

In the following sample of student work, we can see some important changes proposed to some areas in decline in the centre of Derby. Although Derby is close to the famous Heritage area of the Peak District, it does not show that important connection with nature, and most importantly it does not motivate people to walk or cycle. Cycling routes are dangerously mixed with speedy or jammed car traffic, day, and night. The centre of the city is not used a lot at night, too. The students found that central piazzas as the one by the Town Hall and some cultural areas are barely attractive to people. Especially elderly people find it very difficult to even go for a 15-minute walk around the city. The streets are highly polluted in the day, and unsafe to navigate at night; our campus area suffers from dark and unsafe spots to navigate at night as well. Another issue is that green and blue infrastructure does not reach fully the central area of Derby; there is an evident lack of an attractive Green Way for the people, but also for biodiversity as a green connection corridor amongst green parks and Derwent River. In fact, a brook that connects Markeaton Park to our campus hides underground after flood protection works were carried out some decade ago.   Ruth Stephenson-Payne, one of our students who graduated in 2020-2021, not only proposed to

bring back all water sources to the surface but also the Peak District into the city. (See Figures 6 & 7 below).

Figure 6: Bringing back the river through the city © Ruth Stephenson-Payne, 2020-2021

Figure 7: Bring the river around important buildings © Ruth Stephenson-Payne, 2020-2021

Finally, the area of our interest in 2021-2022 for Project Research and Urban Design has been our Campus and the surrounding residential and commercial areas. Once again, the students re-discovered the water courses; they lifted all barriers created by railings and enclosures. Their main thought after restrictions was to show their work to all locals, and especially the elderly and the very young. They declared that they want their studios always to be open to all. So, Gary Dawson, another student who graduated recently based his project by computing the Biophilic Healing Index of our Markeaton campus urban area reaching 35% of biophilia. Gary discovered that the railings along the main paths create a feeling of discontent with a dull pathway to our building and no outdoor seating. The water is present but not accessible, and the greenery is present but oppressive. See Figure 8 for the BHI percentage as exists below, and Figures 9 & 10 for changes to get urban affordances for all:

Zone Measured: Markeaton Walkway	
Category	Score 0-2
B1. Sunlight: preferably from several directions.	1
B2. Colour: variety and combination of hues.	0
B3. Gravity: balance and equilibrium about the	2
B4. Fractals: things occurring on nested scales.	1
B5. Curves: on small, medium, and large scales.	0
B6. Detail: meant to attract the eye.	0
B7. Water: to be both heard and seen.	1
B8. Life: living plants, animals, and other people.	2
B9. Representations-of-nature: naturalistic ornament, realistic paintings, reliefs, and igurative sculptures — including face-like structures.	0
B10. Organized-complexity: intricate yet coherent designs — and extends to symmetries	0
Total out of 20	7
Score as a Percentage	35

Figure 8: Calculation of biophilia along Markeaton Walkway © Gary Dawson, 2021-2022

Figure 9: Removal of barriers and dark tarmac along Markeaton Walkway
© Gary Dawson, 2021-2022

Figure 10: Removal of barriers and safety lights along Markeaton Walkway
© Gary Dawson, 2021-2022

Some more examples from student work for Project Research and Urban Design also show how students managed to propose changes according to the increase of some specific biophilic patterns, such as light, colour, detail, connections with nature and the arts, free flowing mobility for all. See the following Figures 11-14:

Figure 11: Connections between art and nature © Aneesa Ahmed, 2021-2022

Figure 12: Health active corridor at Markeaton and Britannia Mill Campus
© Holly Ann Malia, 2021-2022

Figure 13: The Markeaton Campus Sponge Park © Tang Zi Kieng, 2021-2022

Figure 14: The Markeaton Campus blending with the local community
© Amen Feresenbet, 2021-2022

Conclusion

In conclusion, the tutor and students managed to share research activities and get feedback from an international audience at various conferences recently. Currently, the author is working with international colleagues on a specific framework in which the Biophilic Healing Index makes an important component in it. We are currently exploring Active-Health-Oriented Behaviour Design via a Building and Urban Spaces Ratings Matrix; our main aim will be to get more professionals, educators, and students involved in discussions to explore opportunities for creating a "more inclusive built environment to support people's self-directed behaviors for healthy living" (Tracada, Sorensen Allacci, Aleti, 2022), and especially helping mobility for all.

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Improving the Assessment and Prevention of Falls and Fractures on a Rehabilitation Ward

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Abstract

Background

The National Steering Group and NICE provide guidelines on medical assessment and prevention of falls and fractures (1)(2). This audit assesses and compares quality of practice on an Age-Related rehabilitation ward against these guidelines.

Methods

A Quality improvement project, including all patients(n=31) on an off-site, Age-Related rehabilitation ward was completed. Data on falls and fractures at emergency department presentation and during admission was obtained through chart review. Following education and implementation of a falls pro-forma, a re-audit was completed at four months including all patients(n=40).

Results

In cycle 1, mean age of patients was 80 years (range 56-94), 39%(n=12) were admitted with a fall of whom 66.7%(n=8) had a resulting fracture. In cycle 2, mean age was 82years(range 63–95), 48%(n=19) were admitted due to a fall, of whom 53%(n=10) had a fracture. A falls assessment and bone health review was completed in 39%(n=12) of all patients in cycle 1, and in 41%(n=3) admitted with a fall. This increased to 83%(n=33) of all patients in cycle 2 and 100%(n=40) of those admitted with a fall. Pre-intervention, 23%(n=7) had an inpatient fall compared to 18%(n=7) post-intervention; of these, 43%(n=3) and 14%(n=1) resulted in fractures respectively.

Conclusion

Compliance with national guidelines for prevention of falls and fractures improved with education and implementation of a falls pro-forma. This resulted in a reduction in falls, particularly injurious falls, on a rehabilitation ward. In future, this pro-forma may be implemented in other hospital wards.

Keywords: Falls, Falls Prevention, Frailty, Ageing, Quality Improvement Project

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Introduction

What is a Fall?

The World Health Organization defines a fall as "an event which results in a person coming to rest inadvertently on the ground or floor or other lower level". Injuries related to falls could be fatal or non-fatal (World Health Organization, 2021) . Falls can result in the following complications: Injury, hospitalization, disability, reduced self-confidence, institutionalization, and death.

Epidemiology

Fall is a very common cause of unintentional injury deaths globally, with approximately 37.3million falls requiring medical review annually (World Health Organization, 2021). Globally, over 25 percent of individuals aged 65 and older fall annually; these numbers increase to 32-42% among people aged over 70 years (World Health Organization, 2008). Two-thirds of older people will have repeat fall within 6 months. 50% of falls among older individuals results in injury.

Inpatient falls is one the most frequently reported safety incidence reported in geriatric and rehabilitation wards of hospitals. Falls among inpatients can result in a longer length of admission and poor patient outcomes (Ian D Cameron, 2018).

Risk Factors

There is a plethora of factors that can increase the likelihood of an individual falling. These can be classified as intrinsic and extrinsic factors (see Table 1 below), among these intrinsic and extrinsic factors, they could also be classified as modifiable and non-modifiable risk factors.

Intrinsic Risk Factors

1.   Advanced age
2.   History of Falls
3.   Medical Conditions like; orthostatic hypotension, depression, diabetes
4.   Abnormalities of gait and mobility
5.   Lower limb weakness
6.   Visual Impairment
7.   Cognitive Impairment

Extrinsic Risk Factors

1.   Environmental factors, which include poor lightning and slippery floors among others.
2.   Type of footwear
3.   Medications

INTRINSIC FACTORS	EXTRINSIC FACTORS
Lower limb weakness	Medications
Gait and balance impairment	Environmental factors
Orthostatic hypotension	Foot wear
Previous History of falls	
Previous Stroke	
Visual Impairment	
Cognitive impairment	
Chronic diseases	
Advanced age	

Table 1: Risk factors of falls

Guidelines

The National Institute for health and care excellence (NICE) make evidence-based recommendations on a wide range of topics. These include preventing and managing specific conditions. NICE provided clinical guidelines for assessing the risk and prevention of falls in older people. The aim of this clinical guideline is to reduce the risk and incidence of falls with its associated complications. It was intended for healthcare professionals caring for older individuals aged 65 and over in the community and inpatients. It also applies to Inpatients aged 50-64 who are at a higher risk of falling.

Some of the recommendations include that all older people who make contact with the healthcare system should be screen for falls by taking a detailed history of all previous falls. In patients that this screening identifies recurrent falls in the last year or have presented on account of a fall should have a multifactorial risk assessment performed by a skilled healthcare professional. These assessments help to individualise a multifactorial intervention (National Intitute of Health and Care Excellence, 2013). Elements of the multifactorial risk assessment include:

•   Identification of falls history
•   Assessment of gait, balance and mobility, and muscle weakness
•   Assessment of osteoporosis risk
•   Assessment of the older person's perceived functional ability and fear relating to
        falling
•   Assessment of visual impairment
•   Assessment of cognitive impairment and neurological examination
•   Assessment of urinary incontinence
•   Assessment of home hazards
•   Cardiovascular examination and medication review

Furthermore, The National Steering Group- a joint initiative between the Health Service Executive (HSE), Department of Health and Children and National Council on Ageing and Older people jointly prepared a strategy to "Prevent Falls and Fractures in Ireland's Ageing Population. Some of the recommendations include that if any individual presents with a fall; with an unexplained fall or history of recurrent falls, they will require a multifactorial risk assessment but if they present with one explained fall, they would need to initially have a gait

and balance assessment before considering the need for further multifactorial risk assessment (The National Steering Group, 2008). This multifactorial risk assessment includes:

- Identification of falls history
- Review of medication(s) and their dose(s)
- Assessment of gait, balance and mobility and lower extremity joint function
- Assessment of endurance
- Assessment of osteoporosis risk
- Assessment of vision
- Examination of neurological function, muscle strength, proprioception, reflexes and tests of cortical, extrapyramidal and cerebellar function
- Assessment of cognitive function
- Screening for depression
- Assessment of postural blood pressure
- Assessment of heart rate and rhythm and evidence of structural heart disease
- Assessment of heart rate and blood pressure responses to carotid sinus stimulation if appropriate
- Assessment of home hazards
- Assessment of the older person's perceived functional ability and fear relating to falling
- Assessment of urinary incontinence
- Assessment of Vitamin D deficiency
- Assessment of foot problems and footwear

Methods

This is a quality improvement project Including all patients admitted on a medical gerontology ward at time of data collection. This project assesses and compares the quality of practice on an Age-Related rehabilitation ward against the guideline provided by N I C E and Strategy to Prevent Falls and Fractures in Ireland's Ageing Population reported by the National Steering Group.

Data was gathered retrospectively. A chart review was performed to obtain data on investigations and management of falls and fractures, both at ED presentation and during admission. After the first audit cycle, an Education and implementation of a falls proforma was performed. The falls proforma was completed for all newly admitted patients by the admitting doctor. A Re-audit was completed at four months.

This project was carried out on a medical gerontology ward of a tertiary university teaching hospital where Patients are transferred for ongoing medical treatment, rehabilitation and to await home care/long-term care. The ward is staffed with a full multidisciplinary team (nursing, medical, physiotherapy, occupational therapy, speech and language therapy, dietetics, medical social work, therapy and health care assistants).

i.) Falls assessment to be carried out in all patients
ii.) Likely cause of falls documented – this may be multifactorial, but contributing factors should be identified

1. **History Taking**
   - ☐ Detailed history - nature of each individual fall
   - ☐ Obtain a collateral history of falls, mobility status and any changes in gait
2. **Cardiovascular assessment**
   - ☐ Lying-standing blood pressure
   - ☐ Review ECG
   - ☐ Cardiovascular examination
   - ☐ Previous echo?
3. **Medication review**
   - ☐ Particularly sedatives, opioids, anti-hypertensives
4. **Bone health assessment**
   - ☐ Consider checking vitamin D level
   - ☐ Consider starting all older patients on vitamin D supplementation
   - ☐ Anti-resorptive treatment for those with fragility fractures
   - ☐ Consider DXA for all others (Suggest to GP in discharge letter)
5. **Lower limb examination**
   - ☐ Neurological including gait
   - ☐ Rheumatological

4. **Bone health assessment**
   - ☐ Consider checking vitamin D level
   - ☐ Consider starting all older patients on vitamin D supplementation
   - ☐ Anti-resorptive treatment for those with fragility fractures
   - ☐ Consider DXA for all others (Suggest to GP in discharge letter)
5. **Lower limb examination**
   - ☐ Neurological including gait
   - ☐ Rheumatological
6. **Cognitive assessment**
   - ☐ MMSE or MOCA if no cognitive assessment done prior to transfer
7. **Continence status**
   - ☐ Documentation of continence status in the medical notes
   - ☐ History taken
   - ☐ Likely cause of incontinence documented
   - ☐ Medication / care plan initiated where necessary
8. **Visual Assessment**
   - ☐ Documentation of any conditions affecting vision and if glasses normally worn / available for use on the ward
9. **Multi-disciplinary assessments**
   - ☐ Send OT and physio referrals for all
   - ☐ Consider dietician referral, particularly if there is a risk of fractures
10. **Assess for foot problems and appropriate footwear available for use on the ward**
    - ☐ Assess for foot problems and appropriate footwear available for use on the ward

Figure 1: Admission Falls proforma

Results

Audit Cycle 1

The first audit cycle included a total of 31 patients, 17 of which were female and 14 male. The mean age of these patients was 80 years (age range 56-94). 38.7% [n=12] of these patients were admitted with a fall. 67% of those admitted with a fall had a fracture on admission. Among the patients included, they had an average of 3 falls in the last 6 months.

During the period of admission, 7 of these patients had a fall on the ward and 43% of these resulted in a fracture. This includes at least 1 incidence of hip fracture. 38.7% of all patients had a fully completed multifactorial risk assessment completed while this was fully completed for 41.7% of patients admitted with a fall.

All patients admitted due to a fall were on calcium/vitamin D replacement. However only 66.7% of them were on a bisphosphonate or denosumab.

	Audit 1	
	All patients (%)	Admitted with fall (%)
Admitted with fracture	25.80%	67%
Fall Since admission	22.58%	25%
Fracture since admission	9.67%	16%
ECG	74.19%	58.33%
Lying-standing BP checked since admission	38.70%	66.67%
Lower limb neurological examination	77.41%	83%
Gait examination	77.41%	75%
Lower limb joint examination	41.93%	100%
Continence status	100%	100%
Cognitive assessment	51.60%	41.67%
Have physio reviewed?	100%	100%
Have OT reviewed?	93.54%	91.67%
Past medical history documented	100%	100%
Detailed history of falls	38.70%	100%
Collateral history	51.60%	42%
1. Vit D level checked	80.64%	91.67%
2. Calcium / vit D supplement	90.32%	100%
3. Denosumab / bisphosphonates	35.48%	66.67%

Table 2: Results of Audit cycle 1

Audit Cycle 2

The second cycle was performed 4months after the implementation of the falls proforma as illustrated above (Figure 1). The total number of patients included was 40, which included 23 females and 17 males with a mean age of 82 (age range 63-95). 48%(n=19) of these patients were admitted with a fall and of those admitted with a fall, 53% also had a fracture on admission. In comparison to the first cycle, although this is a higher proportion of all patients admitted with a fall, cycle 2 had a smaller percentage of fracture admissions. Patients in cycle 2 had an average of 2 falls in the last 6 months.

During the period of admission 18% (n=7) had a subsequent fall on the ward and only 1 of these patients had a resulting fracture. In this cycle, 83% of all patients included had a fully completed multifactorial risk assessment and it was fully completed in 89% of those admitted with a fall.

Although all patients admitted with a fall were on calcium/vitamin D replacement, the number of patients on bisphosphonate and denosumab remained 66.7%. See detailed breakdown of comparison of results from cycle 1 and 2 below in table 4 and 5.

Audit 2		
	All Patients (%)	Admitted with falls (%)
Admitted with fracture	25%	52%
Fall Since admission	18%	21%
Fracture since admission	3%	5%
ECG	100%	100%
Lying-standing BP	83%	100%
Lower limb neurological examination	100%	100%
Gait examination	100%	100%
Lower limb joint examination	100%	100%
Continence status	100%	100%
Cognitive assessment	93%	89%
Have physio reviewed?	100%	100%
Have OT reviewed?	100%	100%
Past medical history documented	100%	100%
Detailed history of falls	100%	100%
Collateral history	100%	100%
1. Vit D level checked	95%	100%
2. Calcium / vit D supplement	83%	100%
3. Denosumab / bisphosphonates	38%	68%

Table 3: Results of Audit cycle 2

| Patients Admited with falls		
	Audit 1 (%)	Audit2 (%)
Admitted with fracture	67%	52%
Fall Since admission	25%	21%
Fracture since admission	16%	5%
ECG	58.33%	**100%**
Lying-standing BP	66.67%	**100%**
Lower limb neurological examination	83%	100%
Gait examination	75%	100%
Lower limb joint	100%	100%
Continence status	100%	100%
Cognitive assessment	41.67%	**89%**
Have physio reviewed?	100%	100%
Have OT reviewed?	91.67%	100%
Past medical history documented	100%	100%
Detailed history of falls	100%	100%
Collateral history	42%	**100%**
1. Vit D level checked	91.67%	100%
2. Calcium / vit D supplement	100%	100%
3. Denosumab / bisphosphonates	66.67%	68%

Table 4: Comparisons of results from cycle 1 and 2 among patients admitted with a fall

Comparison of audit 1 and 2 for all patients		
	Audit 1 (%)	Audit 2 (%)
Admitted with fracture	25.80%	25%
Fall Since admission	22.58%	18%
Fracture since admission	9.67%	3%
ECG	74.19%	**100%**
Lying-standing BP	38.70%	**83%**
Lower limb neurological examination	77.41%	100%
Gait examination	77.41%	100%
Lower limb joint examination	41.93%	100%
Continence status	100%	100%
Cognitive assessment	51.60%	**93%**
Have physio reviewed?	100%	100%
Have OT reviewed?	93.54%	100%
Past medical history documented	100%	100%
Detailed history of falls	38.70%	**100%**
Collateral history	51.60%	100%
1. Vit D level checked	80.64%	95%
2. Calcium / vit D supplement	90.32%	83%
3. Denosumab / bisphosphonates	35.48%	38%

Table 5: Comparison of results from cycle 1 and 2 among all patients included
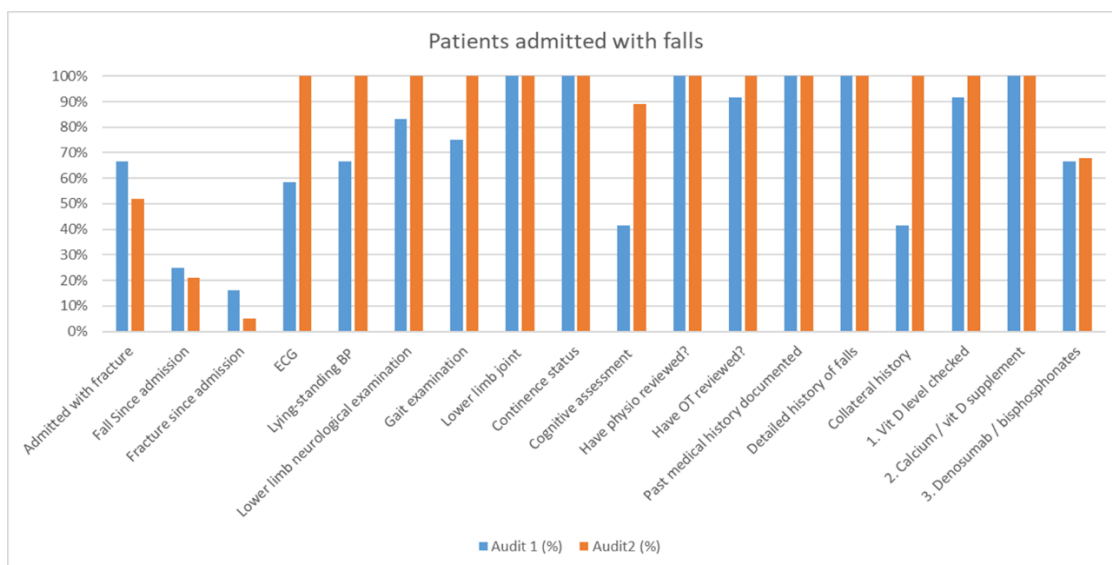
Graph 1: Graphical representation of result comparison among patients admitted with a fall
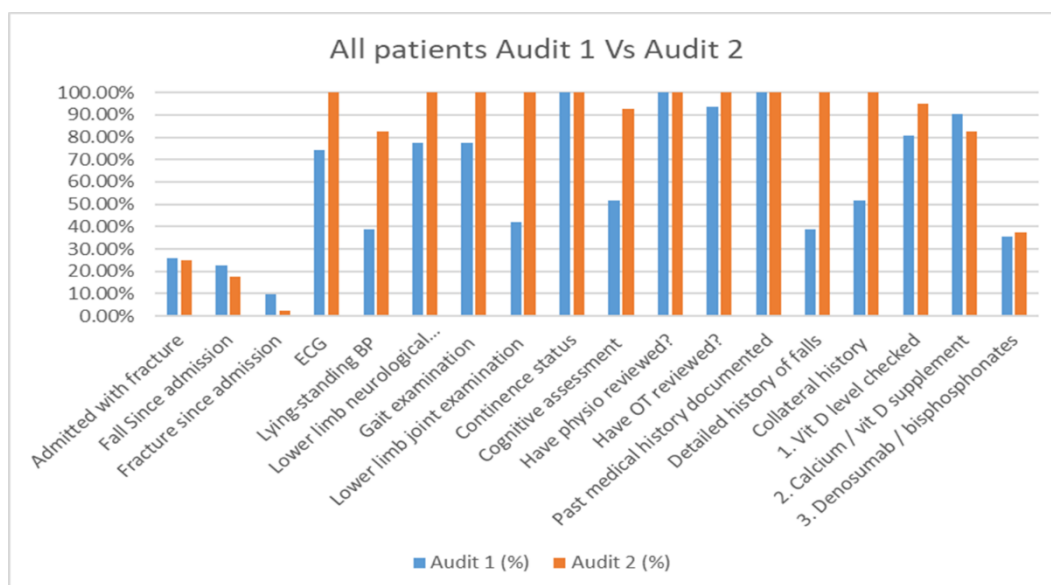
Graph 2: Graphical representation of result comparison among all patients included

Conclusions

In Conclusion, falls become more common with advanced age. The guidelines provided by NICE and HSE recommend evaluating falls risk in all older individuals presenting with a fall and the HSE recommends annual screening. A Proforma can act as a prompt to aid in compliance with multifactorial falls risk assessments.

Following the education and implementation of the falls proforma, Compliance with national guidelines for prevention of falls and fractures improved. There was a reduction in falls, particularly injurious falls, on the ward. However, this cannot be concluded to be because of the intervention as this project included a small sample size.

In future, this pro-forma may be implemented in other hospital wards and reaudited. Additionally, in future projects, bone health could be evaluated more specifically as the results of this project didn't yield much improvement in that area.

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Perception of Digital Integration and Companions for Older Communities in China in Light of the COVID-19 Pandemic

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Abstract
In the era of rapid aging and information superposition, accelerating the digital integration of the elderly and narrowing the digital divide of the elderly are the new requirements and actual contents of encouraging active aging in the digital society. Due to the ongoing pandemic COVID-19, the majority of the world's elderly population reported feeling socially isolated and having infrequent contact with others. The web-based social interaction platforms were the only means by which this segment of the population remained involved and could communicate, indicating that virtual communication has the ability to prevent or significantly reduce seniors' social isolation. It is essential to advocate for technology-based policies and initiatives that encourage internet use among the elderly in order to improve their social and emotional well-being; this could also assist in reducing depression among this demographic. In the older communities of China, a questionnaire survey and interviews were conducted to analyze their perception of digital platforms, experiences using the online social platforms during the pandemic, and their acceptance of such provisions for an engaging living environment and establishing an online and offline knowledge-sharing community. According to the respondents, the Chinese young-old with relatively high levels of education have good adaptability to modern society and demonstrate a strong willingness to share their experience and assist others after retirement using digital media. The majority of respondents regarded social interaction, digitalization, emotional support via digital companions, and self-fulfillment favorably, and had a positive opinion toward adopting current day technology for social and emotional well-being.

Keywords: Aging Population, Digital Divide, COVID-19, Chinese Elderly, Digital Companions

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Introduction

The current century has been a witness to a number of extremely complex challenges that have yet to be overcome, but there have also been numerous breakthroughs that have greatly improved the quality of life. With the continued technological advancements there has been a consistent rise in the numbers of the aging population globally as a direct result with longer lifespan due to improved healthcare systems and declining birth rates. An estimated share of 2.1 billion older people who are 65 years or above are expected to live globally by the year 2050 (*WHO, Ageing and health*, 2021). As living in a society that is transitioning into an aged one globally, there is a greater need in focusing resources to cater to the shortcomings that need immediate attention.

The advancement in media and technology has mostly been a key transformative element in this century and has resulted in enormous development in countless fields. Yet, it has been a bane for several due to the lack of knowledge and other capacities to use it to their benefit resulting in an evident phenomenon of a digital divide (Song et al., 2021). Digital divide due to aging has been a longstanding issue less discussed and even less worked upon in the past decade as the proportions are not regularly distributed. But during the pandemic, when getting outdoors for performing daily activities got a halt for months without a better alternative. The use of internet became imminent and only working solution for many tasks that could be previously done otherwise. The use of tele-medicine to the use of internet for entertainment and being connected with the friends and family became possible through this means. But the overarching presence of this meant a shadowed area of left-alones, who could not make use or take the benefit from the given opportunity during the rapid transition in the past two years of a pandemic.

The study of artificial intelligence is a subfield of computer science that aims to understand the fundamental properties of intelligence and develop a novel kind of intelligent machine that is capable of responding in a manner that is analogous to how humans would respond. A subset of artificial intelligence known as machine learning teaches computers to learn from prior outcomes, and this information is constantly fed back into the systems and machines that are constantly improving themselves based on the generated dataset. Robotics, language recognition, picture recognition, and other forms of recognition, as well as natural language processing and expert system research are all included in this field of study. While these advancements are the widely used in our daily life activities and have successfully transformed and reduced accidents due to human error, a greater scope of applications related to the aging market remains lesser explored. Further adding to the scope, the pandemic highlighted the heightened effects of social isolation and loneliness that emerged in the senior sections of the society as most elderlies who were considered to be more susceptible to the virus had to remain indoors for an indefinite period (Das, 2022). The study aims to analyze the changes in perception of using technology during the pandemic and their attitude towards using digital companions that can help in tackling the issues like loneliness and use them as part of assisted living strategies promoting aging in place. The preliminary study showed promising results as most of the respondents had developed a positive outlook towards the use of modern intelligent services to their benefit and wellbeing.

The impact of aging on the society

The aging of our population is a problem that not only has repercussions for our society but also for our day-to-day lives. According to Chinese custom, the majority of individuals have

a significant responsibility to take care of their family members, particularly elderly family members who are experiencing difficulties due to a disability or chronic ailments. The elderly individuals are dependent on their caretakers for assistance and to help them maintain their day-to-day living. This existing circumstance revealed that there is a potential to enrich both the experiences of the elderly and carers by creating a convenient and comfortable living for them. This would be beneficial for everyone involved. Aside from that, the solution can begin with the prevention of and reduction in the severity of the symptoms before the old people obtained the chronic conditions (McKee et al., 2002). In this study, we explored five areas in which the aging population has exposed societal challenges. Besides that, there has also been a significant rise in the need for residential care services and medical care for the elderly, specifically for the management of chronic conditions.

Implications for the economy- With an aging population and a slipping employment rate, mainland China and its special administrative regions like Hong Kong will have a sliding social capital and a shortage of labor. This could also lower overall productivity. At the same time, dependency ratios will climb, leading to a corresponding increase in the expenses of social security. In addition, there is a growing expectation placed on people of retirement age to keep working, despite the growing number of opportunities available to retirees.

Spending more money on welfare services- Some elderly adults who are retired or who do not have family caregivers require assistance from social security. The cost of welfare benefits (such as the Old Age Allowance) and the burden of social services, amenities, retirement protection, medical and long-term care services are both expected to rise in tandem with the growth of the elderly population.

Healthcare system overstretch- According to the findings of the Census and Statistics Department, approximately seventy percent of the older population residing in the neighborhoods of Hong Kong (*HKCSD, Population Census Summary Results. Hong Kong: Census and Statistics Department, 2011*) is affected by at least one chronic illness. Both the demand for and the cost of providing medical care to senior patients for the management of chronic diseases have seen significant increases in the recent years in the country (Fang et al., 2015).

Rising demand for services for the elderly rising- The necessity for adequate support services for the elderly is increasing as a consequence of the growing demand for community support services and residential care services spurred on by an aging population (*NHCPRC . National Health Commission of the People's Republic of China; 2019. Policy Interpretation of Notice on Strengthening Elderly Care*).

Impact on the families- It is projected that the number of elderly persons who require care will continue to increase in the coming years. The number of elderly people who are retired is on the rise, and it is also anticipated that the number of elderly people who must rely on family members for care will increase.

Two of the impact factors are deeply explored that could guide the following design, striving to make life easier for the people and society as a whole. Factors considered were that there has been an upsurge in the demand for services aimed at the elderly and how to tap the potential market. The second aspect considered for the study is how it affects the families and how the assistance of digital companion can relieve them. There are two models of seniors

living conditions based on location, one is seniors living in their homes, usually accompanied by caregivers (with or without family members). And the other model is living in an institutional setting like elderly care homes etc. For senior people who choose to remain in their homes as they age, the concept of "aging in place" refers to a model of aging in which the family has facilitated living conditions and the members of the family are able to provide care for the elderly. It is a model in which older people belong to families with a middle-class income or higher and are taken care of by family members or domestic helpers. This is a preferred model, despite the fact that this model requires heavy reliance on members of one's own family to provide care, which can be challenging at times for those providing care. The second model involves the elderly people living in nursing facilities that are specifically designed for the aged. This model is characterized by the fact that the elderly people live there. Its core service objective is to provide nursing home facilities and services to seniors 65 and older who are unable to live at home for personal, social, health, or other reasons. The growing demand for services for the elderly has brought attention to the necessity of effective support services (He et al., 2019).

Artificial Intelligence (AI) revolutionizing elderly care

Diseases that affect the elderly require prompt diagnosis and continued supervision by trained carers, but we are not training enough medical professionals or caregivers to fulfill the rising demand for health care services. As a result of this circumstance, healthcare practitioners are beginning to automate certain aspects of the care pathway using artificial intelligence (AI). Artificial intelligence (AI) may now be found at every step of the treatment pathway, from the intelligent surveillance of biometric information to the early identification of disease (Fang et al., 2015). Patients and their families have begun receiving assistance from artificial intelligence in order to better grasp the treatment options available to them. The effectiveness of clinical treatments for various disorders is also being improved with the assistance of artificial intelligence. The care given to older people is being transformed by AI (Tomita et al., 2010). According to the information available in the market industry, there are a great number of smart devices on the market with functions that are created specifically for people of advanced age. There are four broad categories of available products (Sanyal, 2018). a) *Home monitoring*- When it comes to the care of older patients, there is always a requirement for round-the-clock monitoring and a prompt diagnosis. b) *Supported daily living with technology*- To individualize the care provided to each elderly customer through the use of machine learning analytics and wearable sensors. c) *Assisted detection of falls by smart devices*- Check for abnormalities in their biometric data using the built-in feature of the gadget that is driven by AI. Additionally, use the device to detect a significant or severe fall and sound an alarm. d) *Virtual companions*- The shortage of trained carers who are able to assist elderly patients who live alone and need support with their everyday activities.

Aged people who live alone and require daily support as well as companionship are the target population for this service. Both offline and online retail establishments stock a wide variety of goods and services that may be purchased and are tailored specifically to meet the needs of senior citizens. Both the old person's family members and the elderly person themselves might do product searches online. There are a lot of functionalities that are shared between different goods that are made for elderly people. On the other hand, the product is tough for people who are not professionals to comprehend and purchase. Nobody, not even the elderly or their carers, is aware that there are goods available that can alleviate their difficulties. They are only conscious enough to acquire the thing because of their prior knowledge. If they have

never heard of the product through advertising, the newspaper, or the website, then they have typically lost the opportunity to assist the elderly people.

In addition, the majority of senior individuals that require care rely on their caregivers to perform research on available products and select the items that are most suited to meet their needs. The people who provide care are unaware of where they could look for a product that is helpful and valuable. In most cases, they will consult their circle of friends for product recommendations or approach the sales associates at the store directly for assistance. Therefore, the location of the shop and the products that are sold there become crucial aspects that determine whether or not elderly people will be able to obtain the helpful product. It turned out that the imprecise flow of information restricted the product alternatives knowledge that were available. Often senior people themselves are interested in enhancing their quality of life with the products, but they are unsure where to purchase them. A comparative study on the available commercially successful products were studied, identified under the beforementioned categories (Refer Table 1) (Sanyal, 2018).

Product Types		Product Name	Associated Functions
01	At home health monitoring	Biotricity	A medical diagnostic and consumer healthcare technology company dedicated to providing biometric remote monitoring solutions, is implementing device-level AI to improve its remote patient monitoring platform.
		CarePredict	AI is used to continuously detect changes in activity and behavior patterns for early detection of health problems.
		Amazon Echo Orbita Health	Voice-based virtual assistants are using AI to achieve medication adherence and care coordination for older people.
		Careangel	Further optimization of voice-based virtual assistants for nurses and caregivers as a target patient group.
02	Smart device assisted daily living	Apple Fitbit	A smart wearable biometric tracker for a wide range of people, including the elderly and geriatric patients. Elderly patients can use the device's built-in AI to check for inconsistencies in their biometric data, as well as detect and alert them to serious falls or severe falls.
		Aicare	Using machine learning analytics and wearable sensors to provide personalized care for each older consumer.
03	Smart device assisted fall detection	Xsens Kardians Qventus	Constructed artificial intelligence driven fall detectors.
		Starkey	Integrated artificial intelligence-driven fall detector in its hearing aid Livio AI.
		Dinsow Robobear	A virtual home helper for older people who live alone and need daily help and companionship.

| 04 | Virtual companions | Mabu | It is a conversational robot that not only provides tailored conversations for each patient, but also access to hard-to-get treatment data. |
| | | ElliQ | Keeping older people active and engaged by connecting them with their families and the outside world. |

Table 1: Comparative study on the available commercially successful products, adopted from (Sanyal, 2018)

Methodology

Participants

The study was conducted through the analysis done by the recorded responses from the online questionnaire and semi-structured interviews with the older people themselves, family members and caregivers about their experiences during the pandemic and their perceptions regarding the integration of digital companions and technologies into their daily lives. A participatory design workshop to generate design features for the digital companions were conducted from the different stakeholders (n=9). An intensive questionnaire was prepared (29 close-end questions) to understand the perceptions and notions about the advent of the digital applications and raised usage of such technologies during the period of pandemic. The questionnaire was sent through online platforms and a total of ninety-two responses (n=92) were recorded between 20 May 2022 and 20 July 2022. The semi-structured interviews with the different end users also shed light on the adapted behaviors that the family members and the caregivers observed during the similar timeframe. The data collected were then analyzed and future recommendations were then generated for adopting such technological changes in the future. The data collected were then applied to generate design characteristics to develop features for smart companions for the seniors.

Eligibility criteria and target user types

1. Adult who is 65 years of age or older and living with family members and/or needs to be taken care of.
2. Caregiver / friend/ family member who is 18 years of age or older
3. Living in the Mainland China or Hong Kong, HKSAR
4. Requiring the services of a nursing home or assisted-living facility

Discussion and Results

The overall aptitude of the respondents inclined positively towards using the technologies for the elderlies in mainland China during the period of pandemic that mostly kept them engaged indoors, helped in getting urgent treatments through tele-medicine and remain connected with the immediate family members, kins and friends among other benefits. The questionnaire was responded mostly by the family members (n=81, 88.04%) of the elderlies. Since the elderlies themselves are not acquainted using the technologies to a greater extent. The responses recorded were mostly from the caregivers and the family members. Also, as is mostly associated in the Asian cultural context, caregiving is generally linked with the female gender and similar observations have been made in the survey where majority of the respondents were female (n=49, 53.26%). There is a strong response recorded who live in their homes and very less responses came from users staying in nursing homes, this gives limited knowledge

about how the advanced technologies helped to deal with the pandemic in the institutional settings. On the other hand, the workshops conducted shows several key features on how the digital integration powered the daily activities for the elderlies and the care provider as well. The probability of accepting social robots were analyzed through the earlier mentioned methods and it can be inferred that majority of the respondents had a prior knowledge of such products and had a positive response towards the products and its adaptability. Certain functions were highlighted during the interviews conducted and are discussed in the next sections as future features that could be incorporated in the digital companions.

As a common observation that emerged from the study is that the health of the elderly declines and they have difficulties taking care of themselves, some of them will need to use long-term care services that are subsidized by the government or that they will have to pay for themselves. The vast majority of older people in Hong Kong and the mainland desire to continue to receive support from their families, friends, and neighbors while also aging in a setting that is comfortable and familiar to them. (The Elderly Commission undertook a consultancy study on residential care services for the elderly and published the results in 2009 as part of the Residential Care Services Final Report). Some studies concluded that the vast majority of seniors and their families prefer to remain in their own homes as they age, rather than in an institutional setting (Sinclair, 1992). Even in Hong Kong and the mainland China, nevertheless, this is the case. According to the findings of an investigation that was conducted with 435 elderly people in Hong Kong, 73.5% of the respondents indicated that they agree or strongly agree that home care services are superior to residential care services as a form of long-term care service (Das & Lau, 2022) (Lou et al., 2011).

Before working on with the design and the model outlook, at first for better user comprehension and demand analysis, appropriate user research was carried out through the use of participatory workshops and questionnaire as a preliminary feasibility study. From the interactive workshop, it was learnt that it was crucial for the respondents to be able to choose the appropriate product when purchasing products for the elderly, and that some respondents did not know where to acquire the appropriate product. This was one of the aspects that we explored. In addition, the initial evaluation of the dementia stage carried out by AI was deemed satisfactory by the users. Users also desired an intelligent system that would help them recommend the appropriate things for them to buy based on the traits and requirements of their individual profiles, since this would significantly enhance both the effectiveness and enjoyment of their shopping experiences. When it comes to selecting smart companion products, customers are more interested in purchasing pet-based items that have more compact specifications and touchscreens. Users also want karaoke functions to be included in smart companion products. During the course of the workshop, a participatory design process was developed in order to carry out design research, with the goals of identifying potential for subsequent design as well as user demands and pain points. The first thing that needs to be done is to come up with a solution for the product's design for the smart companion. In this stage of the research, the primary objective is to identify user pain areas that are amenable to improvement and to identify the preferences of older users for other characteristics of the product, such as the product's functionality, form, color, and material, among other things.

According to the questionnaire, the responses highlighted that the majority of elderly people live with their families, but that there are also many elderly people who live alone. As a result, when designing a product, both the appearance and the functionality of the product need to be acceptable to elderly people and their families. When designing for older people to assist avoid dementia, it is important to remember that they require companionship and

everyday engagement, therefore aspects such as communication, entertainment, and shopping must be taken into account while the design and interfaces should be able to assist them in narrowing down their options. Additionally, when designing products for seniors, one should place an emphasis on safety first, followed by functionality and lifestyle considerations (García-Vázquez & Rodríguez, 2009). Also, the majority of users do not have a positive experience when purchasing products geared for seniors; consequently, the suggested design needs to assist users in enhancing their shopping experiences and selecting the appropriate products. From the responses, the majority of old people live together as a couple with their children, around 90% live with their own family or caregivers, while about 10.42% live alone. 70% of responders would take the elderly on a regular stroll, 45% would engage in conversation with them, and 40% would play games with them for amusement. The purpose of the questionnaire was to gain insight into respondents' experiences with purchasing things for seniors. The majority of respondents stated they did not know how to choose the proper products, while some said there were so many options that they did not know what to choose and where to get relevant things for older people, and others claimed that some products felt too outdated. They cited three primary reasons: to keep the elderly in the family safe, to prevent disease in the family, and to promote the health of the elderly. Some respondents also reported that they purchased related products to enhance their personal caregiving experience with the elderly. They have frequently purchased daily essentials (goggles, crutches, bath-chairs, calendars) for the senior members of their families, followed by household furniture, massage items, and entertainment products (radios, stereos, tablets, etc.).

Design integration intervention for digital companions

Currently available popular companionship products are mostly separated into pet and monitor display models. However, they all possess the ability to monitor and communicate. In the case of pet products, they are mobile and capable of interacting with the user through facial expressions and sounds. The design orientation of intelligent companion products is classified into four categories: companionship, entertainment, health advice, and user behavior analysis (observation). To stimulate the memory of the elderly, the companionship feature primarily solicits information about the user's family members and displays family photographs. In terms of entertainment, engagement with older users is improved by playing music, reading the news aloud, engaging in interactive storytelling, and performing karaoke. To promote the health of the elderly, simple exercises such as standing up, hand clapping, and stretching are recommended as health advice. Lastly, the device's camera enables the observation of the elderly's daily behavior, allows them to conduct video conversations, and provides product and service recommendations based on the elderly's gathered daily behavior (Refer Table 2).

Application areas	Suggested functions	Benefits for preventing dementia
Companionship	• **Ask questions** related to their family • **Display the photos** of the family members	• Improving the **elderly mood and focus**, the ability to use these applications was affected by the severity of dementia • To recap the **elderly memory**

Entertainment	• Play the music & songs • Play games (family photo quizzes) • Read out the news • Interactive storytelling • Karaoke	• Improving the **level of depression** and **increasing engagement** • **Activating the elderly brain** and recap the memory • Distracting users and reducing wandering behavior
Health Guidance	• **Providing the guidelines** for remaining healthy • Simply Exercise (Stand up, clap hands)	• Improving the living habits and body health
Initial Evaluation/Observation	• Providing the product, service, and activities suggestion • Reminder • Data collection • Video call	• **Connecting** the elderly with family members • Improving **emotional well-being** and **quality of life** • Reduced stress

Table 2: Design characteristics for the digital companions

Conclusion

According to the data collected from the survey, Chinese retirees in their 60s and 70s who have relatively high levels of education are able to adapt well to modern society and exhibit a strong willingness to share their experiences and offer assistance to others through the use of digital media after they have reached retirement age. The vast majority of respondents had a positive attitude toward adopting modern technology for the purpose of improving their social and emotional well-being (Steptoe et al., 2015). These respondents held positive views regarding the importance of self-fulfillment, social interaction, digitalization, and emotional support provided by digital companions. Since personnel shortage has been a constant disadvantage in the senior service sector, the promotion of such companions can definitely reduce the burden on the caregivers. The range of functions that can be attained through these means can be further explored while strictly considering the data sharing policies and privacy issues related to using AI. To be regarded a true companion robot, the path of future research must be toward active companion robots that can initiate conversation, provide recommendations based on user behavior, and form a deep connection with the user. The active companion must offer the user a novel experience. It enables the user to encourage the elderly to utilize the product and strengthens the bond between the user and companion.

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