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The Effects of the Green House Nursing Home Model on ADL Function Trajectory: A Retrospective Longitudinal Study

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Abstract

Background—Growing attention in the past few decades has focused on improving care quality and quality of life for nursing home residents. Many traditional nursing homes have attempted to transform themselves to become more homelike emphasizing individualized care. This trend is referred to as nursing home culture change in the U.S. A promising culture change nursing home model, the Green House (GH) nursing home model, has shown positive psychological outcomes. However, little is known about whether the GH nursing home model has positive effects on physical function compared to traditional nursing homes.

Objectives—To examine the longitudinal effects of the GH nursing home model by comparing change patterns of ADL function over time between GH home residents and traditional nursing home residents.

Design—A retrospective longitudinal study.

Settings—Four GH organizations (nine GH units and four traditional units).

Participants—A total of 242 residents (93 GH residents and 149 traditional home residents) who had stayed in the nursing home at least six months from admission.

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Methods—The outcome was ADL function, and the main independent variable was the facility type in which the resident stayed: a GH or traditional unit. Age, gender, comorbidity score, cognitive function, and depressive symptoms at baseline were controlled. All of these measures were from a minimum dataset. Growth curve modeling and growth mixture modeling were employed in this study for longitudinal analyses.

Results—The mean ADL function showed deterioration over time, and the rates of deterioration between GH and traditional home residents were not different over time. Four different ADL function trajectories were identified for 18 months, but there was no statistical difference in the likelihood of being in one of the four trajectory classes between the two groups.

Conclusions—Although GH nursing homes are considered to represent an innovative model changing the nursing home environment into more person-centered, this study did not demonstrate significant differences in ADL function changes for residents in the GH nursing homes compared to traditional nursing homes. Given that the GH model continues to evolve as it is being implemented and variations within and across GH homes are identified, large-scale longitudinal studies are needed to provide further relevant information on the effects of the GH model.

Keywords

culture change; person-centered care; nursing home; ADL; outcome; growth curve modeling

1. Introduction

1.1. Background

Approximately one-third of adults who are over 65 years require care in a residential facility (Kemper, Komisar, & Alecxih, 2005). Growing attention in the past few decades has focused on improving care quality and quality of life for nursing home residents and many traditional nursing homes have attempted to transform themselves to reflect a more homelike model. Several nursing home providers have initiated new nursing home models emphasizing individualized care within homelike care environments, referred to as “*nursing home culture change*.” This movement attempts to reframe the philosophical view of the person, to transform the physical environment, and to ensure sufficient support for personal preferences (Rabig, 2009). Exemplars of these culture change models include Eden Alternative, Green House (GH) homes, the Wellspring model, and a household model. Core elements of culture change nursing homes include resident-directed care, architecture that reflects a family home, close relationships among staff and residents, staff empowerment, collaborative decision-making processes, and quality improvement efforts (Koren, 2010).

One prevalent culture change nursing home model is GH nursing homes. The GH nursing home model evolved from the Eden Alternative and emphasizes a small-scale, homelike care environment and organizational changes to meet residents’ social needs, with an emphasis on their quality of life. Eight to twelve residents reside in each home, and each resident has a private bedroom and bathroom, and all residents share common spaces including a kitchen, hearth, and dining room where they can gather. The traditional nursing home components such as a nurse station, medication carts, and a paging system are avoided in GH homes. Certified nurse aids (CNAs), called Shahbazim, have a wide range of work

responsibilities and authority. Unlike traditional CNAs, they have expanded universal roles such as preparing meals, shopping, activities, and housekeeping duties including cleaning and laundry (Eliopoulos, 2010; Ragsdale & McDougall, 2008).

With the widespread adoption of culture change nursing homes, many research studies have evaluated the impact of nursing home culture change. Three review articles on the effects of culture change nursing homes have indicated that the effects of culture change nursing homes vary widely in scope and outcomes, and study findings on resident outcomes are mixed or inconsistent (Brownie & Nancarrow, 2013; Hill, Kolanowski, Milone-Nuzzo, & Yevchak, 2011; Shier, Khodyakov, Cohen, Zimmerman, & Saliba, 2014). Particularly the literature on the effects of the GH nursing home model is scarce with only two studies found. Kane (2007) conducted the first study to assess the impact of the GH model after its introduction. The evaluation showed positive psychological outcomes in GH home residents over two years including improved quality of life and increased satisfaction with the nursing home compared to traditional nursing home residents; however, the ADL function of GH nursing home residents was not significantly different compared to traditional nursing home residents (Kane, Lum, Cutler, Degenholtz, & Yu, 2007). Another study demonstrated that the experience of at-homeness and ADL function in GH home residents significantly improved compared to residents in traditional homes over six months, but the small sample size ($n = 25$) makes it difficult to generalize the study's findings related to positive outcomes of ADL function (Molony, Evans, Jeon, Rabig, & Straka, 2011). As the results of these two previous studies, it is difficult to obtain generalizable findings on the effects of the GH nursing home model, particularly about ADL function outcomes.

Given that a major goal of culture change nursing home initiatives has been to improve the quality of life, many studies have pointed to the success of improving psychological outcomes. However, physical function, usually measured by levels of dependence in basic ADLs, is another salient factor for nursing home residents' quality of life (Kane & Kane, 2000). Conversely, ADL impairment is significantly related to poorer physical health, hospital admission, and death (Green, Mohs, Schmeidler, Aryan, & Davis, 1993; McConnell, Branch, Sloane, & Pieper, 2003). ADL function is a comprehensive outcome measure to assess the overall effects of the care that nursing home residents have received (McConnell et al., 2003). In addition, ADL function status is a significant determinant of staff time required for assistance, and directly influences the cost of care. Given the dramatically increasing cost of long-term care, positive outcomes related to ADL function for nursing home residents may be the most important evidence for evaluating new nursing home models.

The current study is novel in that it considers individuals' longitudinal changes over time plus heterogeneity across individuals. The heterogeneity of older adults may cause health outcomes for nursing home residents to change over time in a different pattern across residents and facilities; thus, rigorous methodology is necessary to evaluate the longitudinal effects of the GH nursing home model. The goal of our study is to examine the longitudinal effects of the GH nursing home model by comparing change patterns of ADL function over time between GH home residents and traditional nursing home residents.

1.2 Conceptual Framework

This study was based on the Structure-Process-Outcome (SPO) system model for nursing care quality in nursing homes, which was modified from Donabedian's SPO model (Unruh & Wan, 2004). To emphasize the importance of nursing staff factors in long-term care settings and of inter-relationships between nursing staff factors and other organizational factors, Unruh and Wan's (2004) SPO system model in nursing homes, the nursing staff component was separated from other structural factors (Unruh & Wan, 2004). The SPO system model in nursing homes is based on the theoretical assumptions that good structural factors should facilitate a good care process, which in turn should facilitate good outcomes implicitly or explicitly. Especially other organizational factors (e.g., location, ownership, and facility type) can affect the care process and residents outcome directly and also indirectly influence outcomes through nursing staff factors (Unruh & Wan, 2004).

The GH nursing home model is a multi-faceted intervention to radically redesign the physical environment and care delivery processes of nursing homes. Within a homelike physical nursing home environment (i.e., *organizational factors*), highly trained and empowered nursing staff (i.e., *nursing staff factor*) provide individualized care that respects residents' preferences and choices, and encourages residents' self-care and independence (i.e., *processes*) to prevent decline of residents' ADL function (i.e., *outcomes*). In particular, the physical environment emphasizing residents' privacy with private rooms and bathrooms and nursing staff's care practices to encourage independence may facilitate residents' self-care in their private areas. This approach could improve residents' physical functioning. Encouraging communal meals in a dining area and residents' involvement in unit routines (e.g., laundry, table setup, and cooking) could also stimulate older adults' physical functioning and encourage mobility and ambulation within the unit.

A recent study empirically demonstrated that the GH nursing home model had a longitudinal effect on increasing the probability of residents' social engagement over time compared to traditional home residents (Yoon, Brown, Bowers, Sharkey, & Horn, 2015). They found that based on its fundamental concept of person-centered care, GH home residents are likely to be more involved in activities due to more intensive contact in the small-scale unit and more environmental stimuli using real-world tasks and activities. Increased levels of social engagement have been shown to have a protective effect on mortality (Kiely & Flacker, 2003). Nursing home residents' positive experiences of participating in self-initiated or social activities could generate positive self-esteem and improved self-efficacy and increase the levels of physical strength (White, Kendrick, & Yardley, 2009). These positive experiences may be a potential mechanism of the relationship between social engagement and final care outcomes including ADL function. However, given the nature of ADL decline over time among nursing home residents (McConnell et al., 2003), we hypothesized that one outcome of the GH nursing home model would be less deterioration in ADL function compared to traditional nursing home residents.

The purpose of this study was to examine the longitudinal effects of the GH nursing home model by comparing changing ADL function patterns over time between GH home residents

and traditional nursing home residents. There were two specific research questions in this study.

Specific research question 1—Does the facility type (whether GH or traditional homes) predict a different rate of ADL function change over time?

Hypothesis 1: Controlling for age, gender, comorbidity, cognitive function, and depressive symptoms, the ADL function of GH nursing home residents will deteriorate less over time compared to traditional nursing home residents.

Specific research question 2—Considering the heterogeneity of the changes of ADL function over time, does the facility type (whether GH or traditional homes) predict different “patterns” of change in ADL function over time?

Hypothesis 2.1: GH nursing home residents will have a higher probability of being in the ADL function maintenance group compared to traditional nursing home residents.

Hypothesis 2.2: GH nursing home residents will have a higher probability of being in the ADL function improvement group compared to traditional nursing home residents.

Hypothesis 2.3: GH nursing home residents will have a lower probability of being in the ADL function deterioration group compared to traditional nursing home residents.

2. Methods

2.1. Data Source and Study Sample

This is a retrospective longitudinal analysis study using existing data from the Study of Changes in ADL Assistant Levels in Traditional Nursing Homes and THE GREEN HOUSE Project sites (ADL Study). The source of data in the ADL Study was a minimum data set (MDS) 2.0 including admission, quarterly reviews, significant change, and annual MDS reviews from June 2004 to September 2009. MDS 2.0 for nursing home residents' assessment and care planning has been required in all U.S. nursing homes. The use of MDS 2.0 has been expanded to case-mix reimbursement and creation of public reporting of quality measures at the facility (Mor, Intrator, Unruh, & Cai, 2011).

Four GH organizations were included in this study. From these organizations, nine GH homes and four traditional homes (i.e., main buildings) were included. The total sample size was 242 residents (93 GH home residents and 149 traditional home residents) who had stayed in the facility at least six months from admission. Six MDS assessments, once every three months, from admission (i.e., admission, 3 months, 6 months, 9 months, 12 months, and 18 months) were included in this study to conduct a longitudinal analysis. This study was approved by the University of Wisconsin-Madison's Institutional Review Board.

2.2. Measures

The main outcome, ADL function, was measured using the ADL long-form scale. This scale is a measure of ADL level of assistance based on self-performance in seven activities: bed mobility, transfer, locomotion, dressing, eating, toilet use, and personal hygiene. Each item is coded from 0 to 4. The sum of the seven items ranges from 0 (complete independence) to

28 (total dependence) (Morris, Fries, & Morris, 1999). The ADL long-form scale is considered to be a good measure to detect meaningful changes in the physical function of long-stay nursing home residents (Carpenter, Hastie, Morris, Fries, & Ankri, 2006), and its the most sensitive to changes over time of the three principal summary MDS-ADL scales available (Morris et al., 1999).

The main independent variable was the facility type: whether the resident stayed in a GH home or traditional home. In this study, residents in GH homes were defined as GH residents, and those in main buildings were regarded as a comparison group of traditional nursing home residents. There were no significant differences between GH homes and traditional homes in terms of ownership, organization, location, and proportions of Medicaid payers between the two groups, because the GH homes and main homes were drawn from the same four GH organizations. The only different organizational characteristic was the number of beds; however, the small number of beds in GH homes was one component that was not included as a covariate.

Age, gender, comorbidity score, cognitive function and depressive symptoms at baseline were noted as individual level covariates. The comorbidity score, which ranges from 0 to 9, was computed by adding the number of nine chronic conditions including diabetes mellitus, arthritis, and congestive heart failure. Cognitive function was measured using the cognitive performance scale (CPS) ranging from 0 (intact) to 6 (very severe impairment) (Morris et al., 1994). The CPS measure has been widely used in long-term care studies since the validity of the mini-mental status examination has been questioned (Carpenter et al., 2006; Hartmaier et al., 1995; Morris et al., 1994). Depressive mood was measured by the MDS Mood Scale (MMS). The MMS is calculated using eight mood related conditions including any verbal expression of distress, leaving food uneaten, and refractory mood symptoms. MMS ranges from 0 to 8 with higher values indicating a more depressed mood.

2.3. Statistical Analysis

The impact of missingness in this longitudinal dataset was investigated using a pattern-mixture model (Hedeker & Gibbons, 1997). It demonstrated that it was possible to ignore the missing patterns including whether residents in this study 1) dropped out before 18 months (i.e., non-completers: discharged or deceased) and 2) had missing values during the stay. Thus, all participants who had resided in the nursing homes at least six months regardless of their total length of stay were included in the next modeling process.

Growth curve modeling (GCM) and growth mixture modeling (GMM) were employed in this study for longitudinal analyses. Latent growth curve (LGC) modeling including GCM and GMM is a special case of structural equation modeling for analyzing the relationships between latent factors. Thus, it can apply all of the advantages of structural equation modeling, including the use of model fit indices to select the optimal model, the ability to account for measurement errors, and the ability to handle missing data effectively (Preacher, Wichman, MacCallum, & Briggs, 2008). LGC modeling approaches consider a “change trajectory” that reflects the association of time and changes in variables of interest within an individual subject. The intercept (i.e., baseline or initial status) and slope (i.e., linear rate of change over time) were the latent variables of interest to be estimated across subjects in the

study (Kaplan, 2009). Considering the natural change patterns of ADL function over time, a polynomial model was initially built but the quadratic term was not statistically significant in the model. To build a parsimonious model with better interpretability, a linear GCM was built. Specifically for the first research question, GCM was used to examine the effect of the facility type (GH home vs. traditional home) on the rate of change of ADL function trajectories.

As for the second research question examining the effect of facility type on predicting different patterns of change in ADL function over time, GMM was employed (Jung & Wickrama, 2008). After classifying the entire sample into several distinct subgroups with different ADL function trajectories using the GMM model (number = 4 in this study), a multinomial logistic regression analysis was applied to examine the effect of facility type to predict the class membership, controlling for baseline characteristics. In addition, given that residents were nested within a unit, a multilevel analysis, specifically a random intercept model, was applied to address the clustered data structure. Descriptive analyses were conducted using SAS 9.4, and Mplus 7 was used for GCM and GMM.

3. Results

3.1. Descriptive Characteristics of the Study Sample

As Table 1 shows, the average age of GH home residents was 85 years old, and the proportion of women was 73% in both settings. About half of the residents were diagnosed with dementia at admission. The average comorbidity scores in GH home residents and traditional home residents were 1.9 and 2.3 out of 9, respectively. Table 2 shows the longitudinal change of scores of ADL, cognitive function, and depressive symptoms over time by group.

3.2. Effect of the GH Nursing Home Model on the Rate of ADL Function Change over Time

In Table 3, the unconditional model indicated that the mean ADL function of all study participants deteriorated over time indicating that the slope of ADL function change was 0.42 ($p < .000$). Controlling for age, gender, comorbidity, cognitive function, and depressive symptoms, the conditional model shows that the rate of change of GH nursing home residents was not statistically different compared to those of traditional home residents ($\beta = -0.09$, $p = .637$). Therefore, hypothesis 1 was rejected.

3.3. Effect of GH Nursing Homes to Predict Different ADL Trajectories

3.3.1. Step 1: Classification of ADL Trajectories—To examine the contribution of facility type in predicting different patterns of change in ADL over time, different ADL function trajectories were classified using GMM. The one-class model was followed by sequentially increasing the number of latent classes up to five classes. As Table 3 shows, although the five-class model had the best model fit, the four-class model was selected considering the other criteria for determining the number of classes including parsimony, interpretability, and at least 2.5% of the total count in each group (Babbott et al., 2014). Figure 1 demonstrates the final four trajectories in the graph with the means of the intercept and linear rates of ADL changes in each latent class. Residents in Class 1 (improvement

group with good baseline; 14.5% of residents) had the best ADL function at admission, and the level of ADL function slightly improved over time. Residents in Class 2 (deterioration group with good baseline; 5.9% of residents) also had good ADL function at admission; however, their ADL function became significantly worse over time (slope = 3.11). Residents in Class 3 (maintenance group with moderate baseline; 7.9% of residents) had moderate levels of ADL function at admission, and stayed relatively stable over time. Residents in Class 4 (deterioration group with poor baseline; 71.9% of residents) had the worst status of ADL function levels at admission, and their ADL functions significantly declined over time.

3.3.2. Step 2: Effect of the GH Nursing Home Model to Predict Membership in the Different ADL Function Trajectories—

Table 5 shows the effect of the GH model as a predictor of membership in the latent class using multinomial logistic regression with Class 4 as the reference group (deterioration group with poor baseline) controlling for age, gender, comorbidity score, cognitive function, and depressive symptoms. There was no statistical effect of whether a resident admitted to a GH home would increase the likelihood of being in Class 1 (improvement group with good baseline), Class 2 (deterioration group with good baseline), or Class 3 (maintenance group with moderate baseline) compared to being in Class 4 (deterioration group with poor baseline). This result indicates that the three hypotheses of the second specific research question were rejected.

4. Discussion

This study was designed to examine the longitudinal effect of the GH nursing home model on residents' ADL function. The results show that while the mean ADL function deteriorated over time, the rates of change between GH home and traditional home residents were not different. In addition, four different ADL function trajectories were identified for 18 months after admission, but there was no statistical difference in the likelihood of being in one of the four classes between the GH home and traditional home residents. Given that there were no statistical differences in age, cognitive function, depressive symptoms, and ADL function at baseline, both of the analyses using GCM and GMM indicated no longitudinal effect of the GH model on the ADL function changes compared to the traditional nursing home model at a statistical level ($p < .05$). This finding is consistent with Kane's study reporting that after controlling for baseline ADL function, there was no statistical difference at 18 months after admission between GH home residents and the comparison groups (Kane et al., 2007). The Kane et al. findings are comparable to the findings in the current study in terms of sample size ($N = 140$ in Kane's and $N = 242$ in this study) and the data collection time of 18 months.

Many factors have been identified as contributing to ADL decline for nursing home residents including inadequate nursing care, lack of appropriate supportive or rehabilitative care, or less activity engagement. However, little research has explored the different care processes in GH homes that may influence the ADL function outcome. The unique physical environment of GH homes with self-contained, small-scale units and private rooms and bathrooms, and the staff's care values of encouraging independence for residents are generally expected to have positive ADL outcomes in small-scale nursing homes (Molony et al., 2011). Family-style or communal eating in the dining area in GH homes may also

encourage residents' mobility or walking with or without assistance. However, contrary to the positive expected outcomes of homelike environments on physical function, over-emphasis on an individual's choices and preferences might not lead to positive outcomes in residents' function. As Cutler and Kane discussed, many residents, especially those who were more cognitively intact, were likely to spend more of their time alone in their rooms, and some residents felt noise carried from the common area (Cutler & Kane, 2009). The widespread emphasis of private places in nursing homes seems to be positive in improving residents' quality of life in a sense of independence and autonomy, but an under-stimulating environment in a private space may precipitate residents' boredom, loneliness, and depression, which could be a potential factor in residents' lack of functional outcomes.

Given the importance of the meaningful activities and stimulations that influence residents' function, the quantity of activity-related care in GH nursing homes might be insufficient over time and thus may not lead to a difference in ADL function changes over time between the two groups. Because the GH model encourages residents to participate in routine and normalized daily activities, structured group activities might not be frequently provided. CNAs in GH homes are responsible for organizing activities for residents but they also need to provide direct and indirect care, which is a significantly different staff role in the GH nursing home model compared to the traditional nursing homes (Bowers & Nolet, 2014). Sharkey reported that CNAs in GH homes provide quantitatively more direct care activities and have a higher level of engagement between staff and the residents than in traditional nursing homes (Sharkey, Hudak, Horn, James, & Howes, 2011).

A recent study demonstrated a positive effect of the GH model on residents' social engagement indicating that GH nursing home residents had an increasing probability of being socially engaged compared to traditional home residents (Yoon et al., 2015). Nevertheless, Yoon's (2015) study also showed that the change rates in the level of social engagement were not significantly different between the two groups. The GH nursing home model might have a partial effect on residents' engagement by emphasizing individualized and normalized daily activities, but the lack of official activity personnel due to the small unit size, may lead to residents not having enough opportunities to stimulate physical function (Verbeek et al., 2014). In addition, there is strong evidence that physical exercise training improves older adults' ADL function (Rolland & Puillard, 2009; Weening-Dijksterhuis, de Greef, Scherder, Slaets, & van der Schans, 2011). Given that the majority of nursing home residents have complex clinical needs, expert management by clinicians (e.g., physicians, RNs, physical therapists and occupational therapists) might impact residents' ADL function (Tolson et al., 2011). However, there is no research evidence as to how different ADL related care activities (e.g., meaningful activities, restorative nursing care, physical/occupational therapy and other clinical services) are performed between GH nursing homes and traditional nursing homes. Therefore, more research is needed to compare different kinds of care processes between GH nursing homes and traditional nursing homes, and how these processes influence residents' ADL function.

Although only nine GH units were included in this study, potential variations in nursing care processes across GH units might have influenced the non-significant differences in resident outcomes observed in this study. The GH nursing home is a relatively more standardized

model than other culture change nursing home models, providing extensive training and support by the national organization for new GH adopters including general principles, architecture, and the role of the CNA in each phase of development (Bowers & Nolet, 2014). However, the details of how the other parts should be implemented including the nurses' role have been less developed; thus, implementation of the GH model, particularly the nursing role within the GH model, varied both within and across sites (Bowers & Nolet, 2014). Researchers have identified four nursing care models, Traditional, Parallel, Integrated, and Visitor models, based on these differences across GH homes in role boundaries between nurse and CNA, responsibility for contact with family members or professionals, and the decision authority over residents' daily lives (Bowers & Nolet, 2014). Given that the nurse's role and nursing care delivery processes are under-developed areas in the GH model, further research is needed to understand the detailed care practices and their consequences including care outcomes and to guide leaders to develop more effective implementation of the GH model.

The other interesting finding of the current study was that about 70% of residents were classified into the deterioration group with a poor baseline. McConnell and colleagues also reported that the ADL function trajectory over the course of nursing home residence appeared to decline over time particularly for long-stay residents (McConnell et al., 2003). This could lead to skepticism about focusing on residents' ADL function as a care outcome in nursing home settings. However, increasing ADL dependence has been shown to be a risk factor for multiple negative consequences such as pressure ulcers, hospitalization, or lower quality of life (Research Triangle Institute, 2012). Although some degree of ADL decline may be unavoidable due to the resident's clinical condition, research has indicated that ADL function decline can be reduced through more proactive care and other interventions for some older adults (Boltz, Resnick, Capezuti, Shuluk, & Secic, 2012). Moreover, with a consensus regarding the importance of evaluating each nursing home's competency to minimize or prevent residents' ADL deterioration, the Center for Medicare and Medicaid has used the percent of residents with worsening ADL function as a quality measure at the federal level. Therefore, more strategic research studies to maintain or prevent worsening ADL function by implementing a new nursing home model are needed to mitigate the negative consequences resulting from ADL decline.

4.1. Limitations

There are several limitations in this study. These data were from four GH organizations. A GH organization usually has one main legacy building and more than one GH home unit. The comparison group in this study was residents in the four main buildings. Although the main building homes and GH homes are physically separate on the same campus, the overall organizational vision and policies are likely to be shared by both types of homes under the same organization. This may contaminate the effects of the GH homes versus the control groups of traditional nursing homes, and may threaten the internal validity of the findings. However, Kane's quasi-experimental study showed that outcome differences between the GH and main homes on the same campus were not smaller than those between the GH units and typical traditional nursing homes from non-GH organizations (Kane et al., 2007). Nevertheless, future studies examining the effects of GH nursing homes need to recruit

nursing homes outside of a singular campus for an additional comparison group of traditional nursing homes.

Second, selection bias could be a limitation of this study. Although the descriptive analysis of all the variables included in this study showed that there were no group differences at baseline between the two groups, other resident characteristics might influence different health outcome trajectories including aggressive behaviors and negative mood over time. Because this is a secondary data analysis study based on a parent study with a retrospective longitudinal design, it was impossible to control for all potential characteristics to avoid selection bias. Furthermore, 29 residents in the GH homes moved from the main homes when the new GH home units opened. Residents who had stayed in one of the other nursing homes might have different change patterns over time than those who were newly admitted to the GH nursing homes. Several rigorous methodologies to minimize selection bias such as matching residents' characteristics at baseline and sensitivity analysis would be possible in the future with the use of a larger scale MDS dataset.

Third, this study used MDS data generated by RNs working in the nursing homes. In addition to its primary purpose for resident classification and care plans, MDS data have been widely used as a source of good research data. Despite this history, however, concerns about data accuracy in MDS data and, in particular, the potential for errors in measures of assessment items have been a concern of several investigators (Arling, Kane, Mueller, Bershadsky, & Degenholtz, 2007; Mor et al., 2003). Thus, potential errors regarding data accuracy could be a limitation of this study.

4.2. Future Direction

A large-scale study is needed to examine the longitudinal effects of the GH nursing home model. Since depressive symptoms and cognitive function might change over time, further studies with a larger sample size are needed to address the simultaneous inter-relationships between multiple time-varying variables in one model and to obtain more realistic findings. Moreover, further studies that examine care processes are necessary to provide practical information and concrete strategies for improving care processes for nursing homes and ultimately for improving residents' health outcomes. Because implementation of a specific model is a complex intervention by nature, multiple components were implemented at the same time, which affects all organizational level factors and work processes. Thus, time-and-motion observation studies or qualitative studies are necessary to comprehensively examine the work processes or care practices that may influence care outcomes of the GH nursing home model. In particular, these studies should examine the work environment (e.g., communication, teamwork, and leadership) that may influence nursing staff's care-giving processes (Temkin-Greener, Zheng, Katz, Zhao, & Mukamel, 2009).

5. Conclusion

Although GH nursing homes are an innovative model to make the nursing home environment more person-centered (Zimmerman & Cohen, 2010), this study did not demonstrate significant differences in ADL function for the GH home model residents compared to traditional nursing home residents. Given that the GH model is continuously

evolving with updated and revised educational and support programs (Bowers & Nolet, 2014), more extensive and longitudinal studies are needed to examine how care in the GH nursing homes is different from that in traditional nursing homes, and which differences give rise to improved resident outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What is already known about the topic?

- Green House nursing home model is an innovative program in redesigning nursing home environment into more small-scale and homelike, and emphasizing person-centered care.
- Green House nursing home model has been shown positive psychological outcomes but little known about physical function outcomes.

What this paper adds?

- There was no significant difference in ADL function changes for residents in the Green House nursing homes compared to traditional nursing homes.
- Four different ADL function trajectories were identified for 18 months, but there was no statistical difference in the likelihood of being in one of the four classes between the two groups of Green House and traditional nursing home residents.

Figure 1.

Growth Trajectories of ADL Function for Each Latent Class

Note. Higher ADL function score indicates worse status;

Class 1 (improvement group with good baseline, 14.5% of residents): intercept = 4.06**, slope = -0.48*;

Class 2 (deterioration group with good baseline, 5.9% of residents): intercept = 1.85, slope = 3.11**;

Class 3 (maintenance group with moderate baseline, 7.9% of residents): intercept = 8.50**, slope = 0.59;

Class 4 (deterioration group with poor baseline, 71.9% of residents): intercept = 18.22**, slope = 0.34**;

* $p < .05$, ** $p < .001$.

Table 1

Baseline Characteristics of Residents (N=242)

Variable	GH (n=93) M (SD) / Frequency (%)	Traditional (n=149) M (SD) / Frequency (%)	Group difference (t/X ² value)	p-value
Age	87.2 (7.2)	85.8 (9.7)	-1.27	.206
Female	68 (73.1%)	110 (73.9%)	0.02	.903
Dementia	52 (55.9%)	75 (50.0%)	0.48	.489
Comorbidity score (0 – 9)	1.9 (1.2)	2.3 (1.4)	2.10	.037
Cognitive function (CPS, 0 – 6)	2.5 (1.0)	2.2 (1.2)	-1.51	.132
Depressive symptoms (MSS, 0 – 8)	1.2 (1.9)	0.8 (1.5)	-1.63	.104
ADL function (ADL, 0 – 28)	14.5 (6.7)	14.5 (7.4)	0.01	.989

Note. GH = Green House home residents; Traditional = Traditional home (main legacy home) residents; M = mean; SD = standard deviation; Higher scores of comorbidity scores, cognitive function, depressive symptoms, and ADL function indicate worse status of each measure.

Table 2

Longitudinal Scores of ADL, Cognitive Function, and Depressive Symptoms

Variable	Group	Baseline M (SD)	3 months M (SD)	6 months M (SD)	9 months M (SD)	12 months M (SD)	15 months M (SD)	18 months M (SD)
ADL (0 – 40)	GH	14.5 (6.7)	14.8 (7.0)	15.6 (6.9)	16.7 (6.7)	16.5 (6.7)	16.2 (6.1)	18.5 (4.4)
	Traditional	14.5 (7.4)	14.6 (7.5)	15.1 (7.3)	15.9 (7.2)	16.2 (6.7)	16.7 (6.7)	16.9 (7.0)
CPS (0 – 6)	GH	2.5 (1.0)	2.6 (1.1)	2.6 (1.1)	2.7 (1.4)	2.6 (1.3)	2.8 (1.2)	2.9 (1.3)
	Traditional	2.2 (1.2)	2.3 (1.3)	2.3 (1.3)	2.4 (1.2)	2.5 (1.2)	2.3 (1.3)	2.3 (1.5)
MSS (0 – 8)	GH	1.2 (1.9)	1.3 (1.9)	1.9 (2.3)	2.3 (2.3)	2.6 (2.4)	2.4 (2.1)	2.1 (2.1)
	Traditional	0.8 (1.5)	1.0 (1.7)	1.0 (1.6)	1.1 (1.7)	1.2 (1.7)	1.2 (1.9)	1.2 (1.8)
Number of Residents	GH	93	93	93	76	64	51	37
	Traditional	149	148	145	130	117	97	55

Note. ADL = activities of daily living; CPS = cognitive performance scale; MSS = mood scale score; GH = Green House home residents; Traditional = Traditional home (main legacy home) residents; * p<0.05, ** p<0.01

Table 3
Results of Growth Curve Modeling: Facility Type (GH vs. Traditional) Effects on the Change in ADL Function over Time

Effect	Unconditional model			Conditional model		
	Estimate (SE)	95% CI	p-value	Estimate (SE)	95% CI	p-value
Intercept (I)	14.47 (1.32)	(11.89, 17.05)	<.001	17.16 (6.69)	(4.06, 30.27)	.010
Slope (S)	0.42 (0.08)	(0.26, 0.58)	<.001	-0.03 (0.37)	(-0.76, 0.69)	.926
<i>r</i> (I and S)	-0.35 (0.05)	(-0.45, -0.24)	<.001	-0.32 (0.05)	(-0.41, -0.23)	<.001
Age → I				-0.12 (0.05)	(-0.21, -0.02)	.015
Age → S				0.01 (0.01)	(-0.003, 0.02)	.121
Female → I				1.26 (1.04)	(-0.78, 3.30)	.226
Female → S				-0.25 (0.21)	(-0.67, 0.17)	.243
Comorbidity → I				0.66 (0.51)	(-0.35, 1.67)	.198
Comorbidity → S				0.01 (0.07)	(-0.12, 0.15)	.832
Cognitive function → I				1.90 (0.51)	(0.90, 2.90)	<.001
Cognitive function → S				-0.06 (0.07)	(-0.19, 0.08)	.414
Depressive symptoms → I				0.71 (0.17)	(0.38, 1.05)	<.001
Depressive symptoms → S				-0.06 (0.04)	(-0.14, 0.03)	.198
GH home → I				0.11 (2.02)	(-3.85, 4.06)	.958
GH home → S				-0.09 (0.19)	(-0.47, 0.29)	.637
<i>Model fit</i>						
$\chi^2(df)$ / p-value		50.093 (23) / <.001			111.310 (53) / <.001	
CFI		0.994			0.979	
SRMR		0.066			0.042	

Note. SE = standard error; *r* = correlation; CFI = Comparative Fit Index; SRMR = Standardized Root Mean Squared Residual.

Table 4

Model Fit for Growth Mixture Models with Increasing Numbers of Classes

Model fit indices	One-class model	Two-class model	Three-class model	Four-class model	Five-class model
AIC	13566.111	6905.388	6857.208	6836.846	6802.622
BIC	13663.801	6957.722	6920.009	6910.113	6886.357
Adjusted BIC	13575.046	6910.174	6862.952	6843.547	6810.281
CAIC	13691.800	6972.722	6938.009	6931.114	6910.357
Negative LL	6755.055	3437.694	3410.604	3397.423	3377.311
Class counts	Class 1: 242 (100%)	Class 1: 41 (16.9%) Class 2: 201 (83.1%)	Class 1: 43 (17.7%) Class 2: 185 (76.4%) Class 3: 14 (5.9%)	Class 1: 35 (14.5%) Class 2: 14 (5.9%) Class 3: 19 (7.9%) Class 4: 174 (71.9%)	Class 1: 3 (1.2%) Class 2: 32 (13.2%) Class 3: 172 (71.1%) Class 4: 21 (8.7%) Class 5: 14 (5.8%)

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; CAIC = consistent AIC; LL = log-likelihood.

Table 5

The Effect of the GH Model to Predict Membership in Latent Classes

Variable	Class 1 (n = 35)		Class 2 (n = 14)		Class 3 (n = 19)		Class 4 (n = 174)	
	OR [95% CI]	Wald X ² (p-value)	OR [95% CI]	Wald X ² (p-value)	OR [95% CI]	Wald X ² (p-value)	OR [95% CI]	Wald X ² (p-value)
GH effect [‡]	0.90 [0.41, 1.98]	0.068 (.794)	0.48 [0.12, 1.92]	1.071 (.301)	1.57 [0.58, 4.24]	0.788 (.375)		

Reference group

Note. OR = odds ratio; CI = confidence interval

[‡]The multinomial logistic regression model was controlled by age, gender, comorbidity score, cognitive function, and depressive symptoms at baseline (reference group: class 4).