The Effect of Green House Nursing Home Model on the Health Outcome Trajectories

by

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Abstract

Background

In the past few decades, many traditional nursing homes have attempted to transform themselves from hospital-like environments to be more homelike. This model change is generally referred to as a nursing home culture change which includes comprehensive efforts to redesign nursing home environments and transform care delivery to residents. Although care outcomes are significant and ultimate evidence that shows the effects of the new models, research findings about the resident outcomes are still limited and mixed. The purpose of this study is to investigate the effects of a small-scale nursing home model from the longitudinal health outcome trajectories. This study used Green House (GH) homes in the U.S as a representative small-scale nursing home model, and compared the change patterns of health outcomes over time in GH homes and traditional nursing homes (Main homes) controlling for age and gender.

Methods

This study is a retrospective longitudinal analysis using a minimum dataset (MDS) from June 2004 to September 2009. The total sample size included in this study was 242 residents: 93 GH home residents and 145 Main home residents. The main health outcome measures were ADL function, cognitive function, aggressive behavior symptoms and negative mood symptoms. Covariates were age and gender, which were treated as time-invariant. Latent growth curve modeling was utilized to examine the effect of the facility type on the residents' health outcome trajectories. Through the three steps to build a LGC model for each outcome measure, the following was examined: What was the group effect on three latent variables, intercept (i.e., initial status), slope (i.e., linear rate of change) and quadratic term (i.e., acceleration/deceleration of rate of change) in terms of four health outcome trajectories.

Results

After controlling for age and gender, the following results were found: 1) the ADL function of both groups' of nursing home residents were reported to become worse over time with no statistically differences in intercept, slope and quadratic term; 2) Cognitive function was quite stable over time in both GH home and Main home residents; 3) GH home residents were reported to have a higher linear rate of aggressive behaviors with more significant deceleration over time compared to the Main home residents who showed a stable pattern; and 4) GH home residents were reported to have a higher baseline and slope of negative mood compared to the stable change pattern of Main home residents' mood trajectory.

Conclusion and implications

Trajectories of ADL and cognitive function were not different between the two types of nursing home residents. Trajectories of aggressive behaviors and negative moods were reported to have higher slopes over time in the GH home residents compared to the Main home residents. However, the increasing patterns of behavioral symptoms and negative mood in GH homes are not necessarily negative findings because it may suggest that small-scale nursing homes provide more environmental freedom to express such behaviors and more proactive care to identify and handle residents' negative moods. Furthermore, this study was based on MDS assessed by RNs, in which nursing staff might be more sensitive to recognize residents' changes in behaviors and mood and more likely to report these changes due to the close relationships between the staff and residents in small-scale units. To provide more sound evidence of the small-scale nursing home model, future studies should examine residents' longitudinal outcomes using more appropriate measures such as applying different measurement methods according to the level of cognition to reduce measurement bias. In addition, studies exploring care processes between the different types of nursing homes can provide practical implications for nursing home providers and stakeholders.

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CHAPTER 1: INTRODUCTION

Background

In the past few decades, many traditional nursing homes have attempted to transform themselves from a model driven by clinical and medical concerns and hospital-like environments to be more homelike. Central concerns driving these changes have been; a lack of privacy, choice, autonomy, and general quality of life. Since approximately one-third of adults over 65 years require care in a residential facility at some point in their later lives (Kemper, Komisar, & Alecxih, 2005), and 25% spend the rest of their lives in nursing homes (Gruneir et al., 2007), quality of life has become an important consideration. In the past decade, medically focused care and routinized/institutionalized care environments have been criticized by consumers and policy makers in many countries. Many believe that the medical model is outmoded, and are shifting toward creating neighborhoods and homelike environments. This movement toward more homelike settings is generally referred to as a nursing home culture change which includes comprehensive efforts to redesign nursing home environments and transform care delivery to residents (Koren, 2010). Some examples are the Eden Alternative model, Wellspring, and the Green House (GH) nursing home model.

This trend emphasizing homelike environments to care for older adults in residential settings is not limited to the U.S. Currently, policies in many countries are designed to delay relocation to long-term care facilities, so residents can remain in the community as long as possible. When home care is no longer possible and residential care is needed, it should take place in a setting that is as homelike as possible (Organization for Economic Cooperation and Development, 2005). For example, small-scale nursing homes, using diverse labels, have been introduced in many countries, including GH homes in the U.S., group living care in

Sweden and the Netherlands, and group homes in Japan and South Korea (Seok, 2010; Verbeek, van Rossum, Zwakhalen, Kempen, & Hamers, 2009). Although there seems to be some cross-national variation in characteristics of small-scale nursing home models, one underlying core philosophy (to create homelike environment) is similar and expanding in each country (Verbeek et al., 2009). Although specific culture change models have been implemented and have evolved differently within the diverse and unique contexts of countries in terms of social and cultural environments and government policies, small-scale nursing home models are becoming quite prevalent. The assumptions that small-scale nursing home models may provide better care and improve the quality of life for nursing home residents compared to traditional nursing home care have been made by researchers and policy makers who are concerned about elderly care.

Small-scale nursing home models attempt to reframe the philosophical view of the person, to transform the physical environment, and ensure sufficient support for personal care (Rabig, 2009). Specifically, small-scale nursing homes use a multi-faceted approach: 1) architecture that reflects a family home (i.e., a private room, living room and dining room), 2) care delivery that incorporates significant values of home-type care (i.e., autonomy, choice and self-care), and 3) individual and socio-cultural continuity (Rabig, 2009). These small-scale nursing home models have an implicit assumption that homelike environments will improve person-environment integration and wellbeing (Molony et al., 2011).

Despite widespread adoption of small-scale nursing home models in many countries, little research evidence is currently available about the effects of these models on care outcomes. Given the pressure of the dramatically increasing cost of long-term care, care outcomes are the most significant and ultimate evidence to show the effects of these new models. In the literature, several studies have evaluated the effects of small-scale nursing homes with respect to the stakeholders’ perspectives including the residents, family, and staff.

Multi-dimensional measures of quality of life have been used to show the effects of these new models, but research findings are still limited and mixed, particularly, in relation to clinical outcomes (Kane, Lum, Cutler, Degenholtz, & Yu, 2007; Verbeek et al., 2010; Verbeek, Zwakhalen, van Rossum, Kempen, & Hamers, 2011). Thus, given the rapid expansion of these small-scale, homelike nursing home models, there is an urgent need for scientific research to determine the effects of small-scale nursing homes, which may lead to better understanding of what we can expect them to achieve.

Purpose of the Study

The purpose of this study is to investigate the effects of a small-scale nursing home model on four specific health outcome trajectories of residents. This study used GH homes as a representative small-scale nursing home model, and compared the change patterns of health outcomes over time in GH homes and traditional nursing homes controlling for age and gender. There are four specific aims in terms of different health outcome measures in this study:

1. To compare the baseline and change patterns of ADL function between the two groups.

2. To compare the baseline and change patterns of cognitive function between the two groups.

3. To compare the baseline and change patterns of behavioral symptoms between the two groups.

4. To compare the baseline and change patterns of negative mood between the two groups.

CHAPTER 2: REVIEW OF THE LITERATURE

In this chapter, the relevant literature is reviewed related to 1) small-scale nursing home models, including specific models implemented across countries and 2) research findings related to outcomes of small-scale nursing homes.

Small-scale Nursing Home Models across Countries

United States

The growth of the U.S. elderly populations has raised many serious issues related to long-term care. Increasing awareness of the long-term care quality problems in the 1980s led consumer advocacy groups to voice their concerns, emphasizing residents` rights and the importance of resident assessment in nursing homes. Their efforts to help determine principles of care laid the groundwork for the landmark Institute of Medicine (IOM) report *Improving the Quality of Care in Nursing Homes* in 1986, which emphasized the “home” aspect of the nursing home care more than the “nursing” aspect of nursing homes (as cited in Koren, 2010). One year later, the Omnibus Budget Reconciliation Act (OBRA) was introduced, which required nursing homes to provide sufficient services for their residents and a holistic approach. It explicitly mandated individualized and person-centered care for nursing home residents, and sparked the emergence of the grassroots culture change movement (Koren, 2010). A decade after the establishment of OBRA 1987, public interest grew in new organizational models that could transform the delivery of care in nursing homes, and several pioneering providers began to develop new models that were different from the traditional nursing homes of that era.

These new models are often referred to as a “culture change movement.” They share a common goal of improving the quality of life by providing person-centered care, creating more home-like environments, and empowering direct care staff in long-term care settings. Several innovative culture change models have emerged since the 1990s, including the Eden Alternative, and the Green House (GH), and Wellspring models. Among those models, particularly the GH model emphasizes a small-scale and home-like environment and organizational changes to meet the social needs, emphasizing quality of life for the residents (Reinhard & Stone, 2001). The Eden Alternative was one of the earliest culture change models, transforming care environments into home-like settings by integrating plants, animals, and children into the daily lives of nursing home residents, thereby increasing the quality of life (Eden Alternative, 2011; Thomas, 1996). The GH model evolved from the Eden Alternative, but was a very innovative program in its approach to radically redesign and reconfigure nursing home buildings and environments. A GH home is a skilled nursing facility which should meet the legal requirements of nursing homes under the supervision of CMS. Eight to 12 residents reside in each home. The GH model is a representative small-scale, homelike nursing home in the U.S.

In GH homes, each resident has a private bedroom and bathroom and shared common spaces including a kitchen, hearth (large living room), and dining-room where residents can gather. The components of traditional nursing homes including a nurse station, medication carts and a paging system are avoided in GH homes. Clinical records are stored electronically via a handheld device. 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).

France

The Cantou, which was developed in France in 1968, was the first small-scale, homelike concept for nursing homes (Verbeek et al., 2009). It was introduced principally to decrease care costs, but it also emphasized home like environments for residents in terms of appearance and atmosphere and non-medical care (Ritchie et al., 1992). The Cantou is a community living facility in a separate enclosed area where 12-15 residents live together, each having an individual room and sharing common spaces such as the living-room and kitchen. Residents are encouraged to have their own furnishings and to become involved in daily house work such as meal preparation and cleaning up after meals (Ritchie et al., 1992).

Sweden

During the 1980s, a similar concept to the Cantou in France emerged, group living homes in Sweden and the Netherlands. The group living care model was developed in the early 1980s in Sweden as an alternative to traditional nursing home care for people with dementia when home care was no longer sustainable (Wimo, Asplund, Mattsson, Adolfsson, & Lundgren, 1995). Its fundamental idea was based on offering community, supervision and activities to maintain normal, everyday life as much as possible; thus, it highlighted the importance of homelike environments, including privacy and domestic furnishings and colors (Verbeek et al., 2009). The units based on this model are called group dwelling units, which are mostly located in ordinary blocks of houses (neighborhoods) where six to nine elderly residents live together and are cared for around the clock by formal caregivers consisting of nursing staff and other staff. This model was influenced by Kitwood`s personhood concept, based on the belief that social needs and communion are the essence of care to promote psychosocial well-being of cognitively impaired residents (Norbergh, Hellzén, Sandman, & Asplun, 2002).

United Kingdom

In England and Scotland, special care units, called Domus units, are based on a small, domestic model to help improve residents` lives. A Domus is a small unit that is purposely built or converted from existing wards to units where nine to twelve residents with dementia live together, each having a private room and a shared kitchen/dining room (Verbeek et al., 2009). This model focuses on residents` individual psychological and emotional needs and a comfortable homelike environment, allowing residents to have their own furniture and accessories. In addition to the emphasis on maintaining residents` independence, the Domus units regard the needs of the staff as of equal importance to residents' needs, which may influence the quality of interaction between the staff and residents (Lindessay, Briggs, Lawes, MacDonald, & Herzberg, 1991).

Netherlands

The Netherlands has group living homes (or small-scale living homes) where six to eight residents live together emphasizing daily life in a familiar, homelike, and relatively small environment (Verbeek et al., 2009). Unlike small-scale facilities that usually provide intermediate care between home care and nursing home care, Dutch group-living home care is a complete substitute for nursing home care for older adults with dementia. In 2010, the group-living home facilities covered about 25% of residents with dementia who resided in Dutch nursing homes (Smit, de Lange, Willemse, & Pot, 2012). Similar to small-scale nursing homes in other countries, the physical concept of group living homes is based on the archetype house, and daily life activities are organized by residents, family caregivers, and nursing staff together. Staff perform multiple integrated tasks including medical and personal care, activities, and household chores. Emphasizing the family-like environment, residents and staff form a household where they engage in many tasks together such as preparation of meals (Verbeek, van Rossum, Zwakhalen, Ambergen, et al., 2009).

Japan and South Korea

In Japan and South Korea, there is a type of small-scale long-term care facility called a group home. Group homes were officially established in Japan in 2000 when long-term care insurance was introduced (Verbeek et al., 2009), and in 2008 in South Korea (Seok, 2010). Both group homes are small-scale, homelike, long-term care facilities, and usually house five to nine residents who are eligible for long-term care insurance. In the philosophy of care, group homes give higher priority to residents` freedom and individual needs and privacy rather than traditional medical care or physical safety; thus, it is possible for residents to have personal furniture and belongings in their personal spaces. Since the staff of these group homes try to establish a homelike and non-institutional physical and social environment, they help residents maintain their usual lifestyle reflecting previous life patterns (Seok, 2010; Yokota et al., 2006). Only residents who have a diagnosis of dementia can be admitted to a group home in Japan (Hirakawa et al., 2006); however, Korean group homes do not have any admission restrictions in terms of diagnosis if the person is eligible for long-term care insurance. In addition, many group homes in Japan have implemented progressive policies for end-of-life care, and the number of group homes with such policies is expected to increase (Hirakawa et al., 2006).

Research Findings of the Impact of Small-scale Nursing Home Models

Outcomes on Residents

Every small-scale nursing home model across countries has evaluated the effect on residents in one or two studies. The time to evaluate the effects of small-scale nursing home models in many counties varies depending on its introduction and development. While European countries, except for the Netherlands, developed small-scale nursing home models a fairly long time ago and research studies to evaluate their effect were published in the 1990s, the GH model in the U.S. and group homes in Japan were only recently tested after 2000. For recently conducted studies that examined the effect of the small-scale nursing home model, there are three studies to examine the effect of GH model in the US. These studies were quasi-experimental study designs. The first study was a two-year longitudinal study comparing GH residents and traditional nursing homes residents. This study noted positive outcomes in GH nursing home residents, such as improved quality of life and well-being and increased satisfaction with the nursing home. In addition, although other quality measures including prevalence of behaviors, depression, or restraint use were not significantly different between GH homes and traditional nursing homes, the incidence of decline of late loss of ADLs was significantly less in GH nursing homes (Kane et al., 2007). Another recent study compared the different trajectory of health and experience of at-homeness for six months. Although quite small sample size (GH residents=15, traditional home residents=10) was difficult to generalize the findings, ADL function and experience of at-homeness in GH dwellers was significantly improved during six months over time, while traditional nursing home dwellers have maintained consistent baseline scores (Molony et al., 2011).

Two studies have been recently conducted to evaluate the effects of small-scale living facilities in the Netherlands. One study was a quasi-experimental study including quite large sample size, 124 residents of small-scale living facilities and 135 regular psycho-geriatric nursing home wards, demonstrated no significant effects on quality of life, neuropsychiatric symptoms, and agitation in three measures for 12 months (Verbeek et al., 2010). The other cross-sectional study that examined particularly the level of activity involvement showed residents of small-scale living homes were more involved in overall activities and preferred activities (Smit et al., 2012).

A Japanese study indicated positive effects of group home care for elderly with dementia. Despite observational study without comparison group, residents who admitted to group homes had significant improvements of aggressive behaviors and quality of life compared to baseline scores and the use of psychotropic drugs and antipsychotics decreased gradually. However, there was no significant change of cognitive function. The authors cautiously assume that non-pharmacological effects of group homes which are physically and socially homelike environments could influence residents with dementia positively, which gives significant implications for the management strategies for behavioral disturbances of dementia (Yokota et al., 2006).

Regarding Cantou model in France, one study has examined the impact of cantou model for the demented elderly compared to long-stay hospital regarded as traditional setting for elderly with dementia. With respect to the residents, cross-sectional comparisons showed positive results of physical ADL and cognitive function and depressive moods in the Cantou population; however, controlling for the differences of admission characteristics, these significant differences disappeared (Ritchie et al., 1992). In this study, several behavioral measures were used as crude indirect measures of well-being. Despite no controlling for residents` characteristics, more goal-oriented walking, more verbal communication time with residents, more time to group activities, less alone in room were observed than hospitals in Cantou groups, while communication time with staff and other visitors, time of organized activities and medical activities, and distressed behaviors were not significant between two groups (Ritchie et al., 1992).

Two studies conducted to assess the effects of group living care, Swedish small-scale, homelike nursing homes. As for the residents, the proportion of improved ADL function on group living was higher than traditional homes. The level of motor, emotional, and intellectual functions and dementia symptoms were significantly different between group living residents and traditional nursing home residents after six months; however, those differences disappeared after 12 months (Annerstedt, 1993). Annerstedt reported one more study that observed same population for longer periods, and positive effects on group living residents that marked peak at six months. After three years, the two groups indicated similar pattern of change of physical function and behavioral symptoms, and survival and length of stay were also not different between two groups (Annerstedt, 1994). Regarding care processes, the use of Psychotropic drug in group living care was less (Annerstedt, 1993), and the resident times with staff and other residents were more in the more creative climate group living care (Norbergh et al., 2002).

Two studies have evaluated the impact of Domus model on residents in the U.K. A comparison study demonstrated significantly higher levels of activities and interactions between staff and residents in Domus compared to two mental hospital psycho-geriatric wards, although it is difficult to draw any conclusion about the impact of the Domus philosophy due to the uncontrolled cross-sectional comparison design. However, cognitive impairment, depressive signs, and level of adaptive behaviors were not significantly different (Lindessay et al., 1991). The other prospective study examined the impact of Domus model to assess at baseline in long-stay mental hospital wards, and every three months after the move to a domus for the first year. It demonstrated that resident`s cognitive and ADL function improved steadily and levels of activities and interpersonal interactions increased in domus, although significant time point was different across measures or Domus types (Dean, Briggs, & Lindesay, 1993).

Outcomes on Family and Organization/staff

Seven studies with four small-scale nursing home models including GH homes, the Cantou model from France, the group living model in Sweden and small-scale living in the Netherlands conducted to evaluate the impact of the model on families. Family outcomes included the followings: less family burden (Annerstedt, 1993, 1994; Ritchie et al., 1992; Ritchie & Ledésert, 1992), increased family involvement (Lum, Kane, Cutler, & Yu, 2008), and better family satisfaction (Lum et al., 2008; Ritchie et al., 1992; Ritchie & Ledésert, 1992; Verbeek et al., 2010, 2011). Regarding family burden, a French Cantou model study reported lower stress levels for family caregivers (Ritchie & Ledésert, 1992) and the group living model in Sweden showed decreased severe psychological strain for family members (Annerstedt, 1993) and less strain and environmental burden (Annerstedt, 1994); however, the GH model study did not find a significant difference in family burden compared to traditional nursing homes (Lum et al., 2008). Nevertheless, family members of residents in the GH nursing home reported a positive global rating when asked if this was a good place to live and if they would recommend it to others (Lum et al., 2008).

Four small-scale nursing home models in France, Sweden, the Netherlands, and the U.K. were assessed in terms of the staff or organizational level outcomes in five studies. The main staff and organizational outcome measure of small-scale nursing home models was job satisfaction. While there was no significant difference in job satisfaction and motivation for nursing staff in the small-scale living model in the Netherlands (Verbeek et al., 2011), the other three models found a positive level of job satisfaction for the nursing staff (Annerstedt, 1993; Lindessay et al., 1991; Ritchie et al., 1992). In addition, staff from the group living facilities reported better competence to handle behavioral symptoms of residents with dementia compared to those in the traditional settings in Sweden (Annerstedt, 1993) and nursing staff from Dutch small-scale nursing homes felt greater sense of autonomy, self-confidence, and responsibility for their work (Verbeek et al., 2010). However, one study examining the effects of the Domus care homes indicated not significant staff outcomes such as staff absenteeism, psychological impairment of staff, or job turnover (Lindessay et al., 1991).

Table 2.1 Research Findings of Small-scale Nursing Home Effects

Country (Model)	Study	Design (Follow-up period)	Sample	Analysis	Outcomes: Residents	Outcomes: Family	Outcomes: Organization /Staff
USA (GH)	Kane et al. (2007)	Quasi-experimental (baseline, 6, 12 & 18 months)	Exp:Con1:Con2 = 39:64:37	Regression	- Quality of life ↑ (privacy, meaningful activity, relationship, autonomy, spiritual wellbeing, security, individuality) - Emotional well-being ↑ - Satisfaction with the nursing home ↑ - Incidence of functional decline ↓ (other quality measures ↔) - Self-reported health, ADLs, IADLs ↔		
	Molony et al. (2011)	Quasi-experimental (baseline, 3 & 6 months)	Exp:Con = 15:10	Mixed model for repeated measures	- Functional decline ↓ - Feeling of at-homeness ↑ - Depressive symptoms ↔		
	Chang et al. (2013)	Retrospective longitudinal (baseline & 12 months)	Exp: Con = 35:33 Using MDS	T-tests	- Self-performed eating ability, daytime sleepiness, restraint use ↑ - Fall incident ↓ - Other measures ↔		
	Lum et al. (2008)	Quasi-experimental (baseline, 6, 12 & 18 months)	Exp:Con1:Con2 = 39:38:40	Regression		- Family involvement ↑ - Family satisfaction ↑ - Global ratings ↑ (place to live & get care, recommend to others) - Family burden ↔	

Note. Exp = Experimental group; Con = Control group; ↑ better or improved; ↓ worse or deteriorated; ↔ not significant change or difference

Country (Model)	Study	Design (Follow-up period)	Sample	Analysis	Outcomes		
					Residents	Family	Organization/ Staff
France (Cantou)	Ritchie et al. (1992, a)	Cross-sectional	Exp:Con = 106:204	t-test		- Satisfaction with care ↑ - levels of stress for family caregivers ↓	
	Ritchie et al. (1992, b)	Quasi-experimental (baseline & 12 months)	Exp:Con = 110:242	ANOVA,	- Changes in physical and cognitive function, and depressive mood ↔		
		Cross-sectional		t-test	- Frequency and duration of goal-oriented walking ↑ - Verbal communication time with residents ↑ - Time in group activities ↑ - Time alone in room ↓ - Repetitive agitated movement time ↓ - Communication time with staff and other visitors ↔ - Frequency and duration of organized activities and medical activities ↔ - Times of distressed behaviors ↔	- Overall satisfaction ↑ - Positive responses ↑ (person in care happy, feels staff interested in family option) - Negative responses on items ↓ (physical comfort insufficient, caregiver wishes further involvement in care, requires more staff contact, worried, needed more information on care options, difficulties in visiting elderly person)	- Job satisfaction ↑ - Predicted staff turnover rates ↓

Note. Exp = Experimental group; Con = Control group; ↑ better or improved; ↓ worse or deteriorated; ↔ not significant change or difference

Country (Model)	Study	Design (Follow-up period)	Sample	Analysis	Outcomes		
					Residents	Family	Organization/Staff
Sweden (Group living)	Annerstedt (1993)	Quasi-experimental (baseline, 6 & 12 months)	Exp:Con = 28:31	Mann-Whitney test	- Physical activity ↑ - Symptoms of dementia ↑ - Adaptive or insufficiency reactions ↑ (Better outcomes were significant at 6 month but not at 12 months) - Use of psychotropic medications ↓	- Severe psychological strain on family members ↓ - Positive attitude towards dementia and the type of care given ↑	- Competence of staff to handle behavioral symptoms ↑ - Job satisfaction ↑
	Annerstedt (1994)	Quasi-experimental (baseline & 3 years)	Exp:Con = 28:28	Repeated measures ANOVA	- Dementia symptoms ↓ - Functional decline ↓ (Most marked at 6 months and no difference after 3 years) - Survival ↔ - Length of stay ↔		
	Andren et al. (2002)					- Degree of total burden ↓ - Strain and environmental burden ↓	

Note. Exp = Experimental group; Con = Control group; ↑ better or improved; ↓ worse or deteriorated; ↔ not significant change or difference

Country (Model)	Study	Design (Follow-up period)	Sample	Analysis	Outcomes		
					Residents	Family	Organization/ Staff
Netherlands (Small-scale living/Group living)	Verbeek et al. (2010)	Quasi-experimental (baseline, 6 & 12 months)	Exp:Con = 124:135 (residents) 106:100 (family) 114:191 (staff)	Repeated measures ANOVA	- Quality of life ↔ - Neuropsychiatric symptoms and agitation ↔	- Satisfaction with the care delivery ↑	- Feeling of involvement and personal contact with residents ↑ - Sense of autonomy of work ↑ - Responsibility, and self-confidence ↑
	Smit et al. (2012)	Cross-sectional	Total residents =1,327	Regression	- Involvement in overall and preferred activities ↑		
	Verbeek et al. (2011)	Cross-sectional & qualitative interview	Exp:Con = 67:63 (family) 101:208 (staff)	t-test/ X^2 test		- Family satisfaction ↑ (personnel attention given to residents, involvement with residents, emphasis on autonomy in daily life)	- Job satisfaction and motivation ↔

Note. Exp = Experimental group; Con = Control group; ↑ better or improved; ↓ worse or deteriorated; ↔ not significant change or difference

Country (Model)	Study	Design (Follow-up period)	Sample	Analysis	Outcomes		
					Residents	Family	Organization/Staff
UK (Domus)	Lindesay et al. (1991)	Cross-sectional (2 control groups)	Ex:Con1:Con2 = 27:25:29	Kruskal-Wallis test, Mann-Whitney test	- Activities of residents ↑ - Interaction between staff and residents ↑ - Cognitive impairment ↔ - Depressive signs ↔, - Level of adaptive behaviors ↔		- Job satisfaction↑ - Staff absenteeism ↔ - Job turnover ↔ - Psychological impairment of staff ↔
	Dean et al. (1993)	Observational study (2 types of Domus) (baseline, 3, 6 & 12 months)	A:B = 12:12	Wilcoxon matched- pairs signed-ranked test, Mann-Whitney test	- Cognitive function ↑ - ADL function ↑ - Levels of activities ↑ - Interpersonal interactions ↑		
Japan (Group home)	Yokota et al. (2006)	Observational study (baseline and 6 months)	N=8 (No comparison)	Friedman test, Wilcoxon sign-rank test	- Aggressive behaviors ↑ - Quality of life ↑ - Change in cognitive function ↔ - Use of psychotropic drugs ↓		

Note. Exp = Experimental group; Con = Control group; ↑ better or improved; ↓ worse or deteriorated; ↔ not significant change or difference

Summary of Literature Review

Although small-scale nursing home models vary across countries, there are common core concepts of these social care models that focus on improving residents' psychological well-being (Verbeek et al., 2009). First, the social care concept incorporates physical domestic characteristics to create a homelike environment. Regarding the scale, it is quite small where less than ten residents usually live together like a family, and interiors and exteriors are designed to be familiar and appealing (Verbeek et al., 2009). The other fundamental change is the philosophy of care that encourages and supports residents' choices and autonomy. This has a connection with the concept of person-centered care, a main concept in nursing home culture change movements in the U.S. (Koren, 2010), in which residents are provided with self-directed and individualized care that supports their highest level of function in a way that respects their preferences (Eliopoulos, 2010). The third common component of small-scale nursing home models is the care staff. Since the underlying organizational culture is to create homelike environments and encourage residents to participate in daily life, nursing staff in small-scale nursing homes integrate many tasks. In addition, staff are empowered and given greater autonomy in daily activities along with greater responsibility and self-confidence (Verbeek et al., 2011).

Although small-scale nursing home models are widely adopted in many countries with a philosophical foundation, little research evidence is currently available about the effects of these models on care outcomes. There are only eleven quantitative studies that have examined the resident outcomes of small-scale nursing home models. Research findings in relation to clinical outcomes are mixed. In addition, the majority of studies were conducted when a new model was first developed and implemented, but few consistent replication studies to observe or examine the longitudinal impact have been conducted.

In addition, many of the studies that have examined the effect of small-scale nursing homes have suffered from methodological limitations. In particular, it is important to use a longitudinal study design to examine the impact of an intervention and the patterns of change over time, as old residents need sufficient time to adjust to new environments and care outcomes may change in non-linear patterns. However, studies in this review have only investigated the effects of small house nursing homes compared to traditional nursing homes using a cross-sectional design (Linsey, 1994; Ritchie et al., 1992) or quasi-experimental design with short follow-up time (Molony et al., 2011; Smit et al., 2012). In addition, small sample sizes, lack of comparison groups, and insufficient adjustment of resident characteristics have been identified as limitations (Annerstedt, 1993; Molony et al., 2011; Yokota et al., 2006).

Based on these critical reviews of literature, this study was designed to investigate the effects of a small-scale nursing home model on residents` health outcome trajectories with larger study sample than previous studies. This study used GH homes as a representative small-scale nursing home model, and compared the change patterns of health outcomes over time in GH homes and traditional nursing homes controlling for age and gender. There are four specific aims in terms of different health outcome measures in this study:

1. To compare the change patterns of ADL function between the two groups.
2. To compare the change patterns of cognitive function between the two groups.
3. To compare the change patterns of behavioral symptoms between the two groups.
4. To compare the change patterns of mood between the two groups.

CHAPTER 3: METHODS

Design

This study is a retrospective longitudinal analysis from the Study of Changes in ADL Assistant Levels in Traditional Nursing Homes and the Green House Project sites (ADL Study.)

Data Sources

Data were from the ADL Study funded by the Robert Wood Johnson Foundation. The ADL Study was conducted by International Severity Information Systems/Institute for Clinical Outcomes Research (ISIS/ICOR) and Health Management Strategies (HMS) in 2010 (ISIS/ICOR & HMS, 2010). The source of data in the ADL Study is a minimum data set (MDS) data including admission, quarter, significant change, and annual MDS reviews. Collected data were MDS data from June 2004 to September 2009.

Study Sites

A total of four GH organizations participated in the parent ADL Study. GH organizations are defined as the organization with at least one GH home unit. Usually GH organizations have one traditional legacy building (called the "Main" home, hereafter) and one or more GH home units. In this study, four Main homes and nine GH homes from four GH organizations were included (organization A: 1 Main home, and 4 GH homes; organization B & C: 1 Main home, and 2 GH homes; and organization C: 1 Main home and 1 GH home). All four organizations were not-for-profit; three of them were located in urban areas and one was in a suburban area. Although specific staffing levels of these four GH organizations were not available, another study with seven GH organizations included four

GH organizations in their study conducted by the same researchers as the parent study, indicating that there was no difference in the total staffing level. However, the total nursing staff hours (i.e., CNAs, licensed nursing staff excluding administrative nursing hours) in GH homes were significantly higher than those of the Main homes, and the total non-nursing staff hours (i.e., housekeeping, laundry, dietary, dietitian, activities and staff education) in the Main homes were significantly higher than those of the GH homes (Sharkey, Hudak, Horn, James, & Howes, 2011). This difference between the two groups is due to the different job descriptions of CNAs in GH homes, where CNAs (called as "Shahbaz") integrate nursing care as well as non-nursing care as part of their daily work rather than using other non-nursing care staff.

Study Sample

Data from older adults who had resided at least six months or had at least three MDS assessments in traditional nursing homes and GH homes were used for this study. GH residents were all residents admitted to the GH with a length of stay of at least six months or who had at least three MDS assessments. The Main building residents were residents residing in the main facility after the first GH opening date for a minimum of six months. Residents who were admitted for short-term rehabilitation and hospice care were excluded; however, if residents stayed prior to a hospice admit, they were included in the study sample.

The total sample size was 255 residents at baseline; however, the study sample with a length of stay of at least six months included in this analysis was 242 residents: 93 in GH home residents and 149 traditional nursing home residents. The analytic method for this study, the latent growth curve (LGC) model, was influenced by the study sample size in terms of the convergence rates, measures of model fit, and the proportional variability of the parameter estimates. At least 50 participants are needed to obtain model convergence, and samples of at least 100 are generally recommended to run the latent growth curve models with a stable range of parameter estimates (Hamilton, Gagne, & Hancock, 2003). Based on this recommendation, the sample size of this study was sufficient to run the LGC modeling. The University IRB has reviewed the study and determined that there was an exemption for this study.

Measures

Health Outcome Measures

ADL function

In this study, ADL function was measured using the ADL long-form scale, which is a measure of the 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 (independence) to 4 (total dependence). 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 physical function in long-stay nursing home residents (Carpenter, Hastie, Morris, Fries, & Ankri, 2006), and is the most sensitive to changes over time of the three principal summary MDS-ADL scales available (Morris et al., 1999).

Cognitive function

Cognitive health outcome was measured using the cognitive performance scale (CPS). The CPS measure has been used frequently in studies, since validity of the instrument, Mini Mental Status Examination (MMSE), has been adequately examined (Carpenter et al., 2006; Hartmaier et al., 1995; Morris et al., 1994). The CPS was derived from four items: two cognitive items (short-term memory and decision-making), one communication item (ability to make oneself understood), and one ADL item (eating). Based on the algorithm using these four items, CPS classifies nursing home residents into seven levels of cognitive function ranging from 0 (intact) to 6 (very severe impairment). In this study, CPS was considered as a continuous variable. The CPS has been widely used with good psychometric properties, specifically high criterion validity with the MMSE and Global Deterioration Scale and high reliability including inter-rater reliability and internal consistency (Shin & Scherer, 2009). The detailed algorithm of the CPS calculation is presented in Appendix A.

Aggressive behaviors

Aggressive behavior was measured using the Aggressive Behavior Scale (ABS). The ABS is a summary score of four items in MDS 2.0: verbal abusive, physical abusive, socially inappropriate or disruptive, and resisting care. The frequency of these items over the previous seven days is coded as 0 (not exhibited), 1 (behavior occurred 1 to 3 days), 2 (behavior occurred 4 to 6 days), or 3 (behavior occurred daily). Based on these four items, the summary score ranges from 0 to 12, with a high ABS score indicating greater frequency of aggressive behaviors. The Cronbach`s alphas of the ABS range from 0.79 to 0.93 in three types of samples, indicating good internal consistency, and the correlation with the Cohen-Mansfield Agitation Inventory (CMAI) was 0.72 ($p<.001$), indicating good concurrent validity (Perlman & Hirdes, 2008).

Mood

Depressive mood was measured by the MDS Mood Scale (MMS). The MMS is a quality measure used by CMS, which is defined as the number of eight conditions (any verbal expression of distress, shows signs of crying, tearfulness, motor agitation, leaves food uneaten, repetitive health complaints, repetitive verbalizations, negative statements, and mood symptoms not easily altered). These eight conditions are represented by ten MDS items, including nine items from the Mood section, and one item from the Oral/Nutrition Status section. The MSS ranges from 0 to 8 with higher values indicating a more depressed mood. The detailed calculation process of the MSS is presented in Appendix B.

Covariates

Age and gender were included as covariates in four latent growth curve models in the final step based on a previous study (Kane et al., 2007). Both covariates were treated as time-invariant variables measuring their impact on the intercepts and slopes (or quadratic terms) of ADL function. Age was a continuous variable, and gender was a dichotomous variable that was coded as 0 (male) and 1 (female).

Facility Type

Main homes and GH homes were coded as 0 and 1, respectively.

Table 3.1 Definition and Description of Variables

Category	Variable	Variable	Level of measurement
Health outcomes	ADL function	ADL long-form scale (0-28)	Continuous
	Cognitive function	CPS (0-6)	Continuous
	Aggressive behaviors	ABS (0-12)	Continuous
	Negative mood	MMS (0-8)	Continuous
Covariates	Age		Continuous
	Gender	(0) Male, (1) Female	Dichotomous
Independent variable	Facility type	(0) Traditional nursing home, (1) GH homes	Dichotomous

Note. ADL = activities of daily living; CPS = cognitive performance scale; ABS = aggressive behavior scale; MSS = mood scale score; High scores of ADL, CPS, ABS and MSS indicate worse status.

CHAPTER 4: DATA ANALYSES AND RESULTS

Preliminary Data Analysis

Data Construction

All residents were usually assessed every three months using the MDS by RNs. However, in some cases, assessment intervals were less than or more than three months if, for example, there was a significant change of health status. Because LGC models need data with the same assessment intervals across participants, the assessment data with the same time interval (e.g., baseline, three months or six months) were constructed. The logic to construct data was that starting from the first assessment date (i.e., baseline assessment), the second expected date was calculated after three months from that first assessment date. The second assessment was selected as the closest one to the second expected assessment date among one or more assessments within a banding period of 1.5 months before and after the second expected date. Consecutive assessment data every three months were selected based on the same processes. Table 4.1 shows the number of residents at each time point. Since inclusion criteria for this study were residents who had stayed in a nursing home for over six months, the number of residents at baseline was the same as those at six months. The total number of the residents included in this study was 242, including 93 GH residents and 149 Main home residents. Some residents (n = 29) had the same ID numbers since they moved to a GH home from a traditional nursing home when a new GH unit opened. Data construction and descriptive data analyses were conducted using SAS, SPSS and NCSS, and LGC modeling was performed with Mplus 6.12.

Table 4.1 Number of Residents at Each Time Period Included in This Study

	Baseline	3 months	6 months	9 months	12 months	15 months	18 months
GH	93	93	93	76	64	51	37
Main	149	149	149	130	117	97	55
Total	242	242	242	206	181	148	92

Sample Characteristics at Baseline

Table 4.2 describes the demographic characteristics of the two groups of this study at baseline. The average age of GH home residents was 87.2 (SD = 7.2) and that of Main home residents was 85.8 (SD = 9.7). The proportions of female were 73.1% and 73.9% in GH homes and Main homes, respectively. Both age and gender used for covariates in the models did not have statistical differences between the two groups when the t-test and X^2 test were applied. About half of the residents were diagnosed with dementia at admission (55.6% in GH homes and 50.0% in Main homes, respectively). The average comorbidity scores in GH home residents and Main home residents were 1.9 (SD = 1.2) and 2.3 (SD =1.4), respectively.

Table 4.2 Baseline Demographic Characteristics of Residents (N=242)

Variable	GH home residents (n=93)		Main home residents (n=149)	
	M (SD)	Frequency (%)	M (SD)	Frequency (%)
Age	87.2 (7.2)		85.8 (9.7)	
< 65		0 (0.0%)		4 (2.7%)
65 ≤ < 80		16 (17.2%)		29 (19.6%)
80 ≤ < 90		39 (41.9%)		55 (37.2%)
≥ 90		38 (40.9%)		60 (40.5%)
Female		68 (73.1%)		110 (73.9%)
Dementia		50 (55.6%)		72 (50.0%)
Comorbidity score (0 – 9)	1.9 (1.2)		2.3 (1.4)	

Note. M = mean; SD = standard deviation

Descriptive Analysis of the Main Variables over Time

Regarding the four health outcome variables, the mean and SD of each group were computed, and the mean difference by group was compared using a t-test at each time point. As Table 4.3 shows, the observed ADL scores in both groups were likely to deteriorate over time, but there was no significant group difference between GH home residents and Main home residents over time. The group means of CPS scores were not so different from baseline to 12 months, but the mean difference by group increased at the points of 15 and 18 months to a statistically significant level. The mean of the cognitive function in GH home residents was rated to be worse than the Main home residents at 15 months from admission, but averages of the CPS in both groups were still at the mild impaired level ($2 \leq CPS < 3$). The overall observed ABS scores were quite low and not likely to change over time; furthermore, the mean differences by group were not significant except at nine months. The means of the mood scores in both groups tended to become worse over time. The average mood score of GH home residents was reported to be significantly worse than Main home residents from the six months from admission until the last assessment (18 months).

Table 4.3 Descriptive Outcome Measures by Group at Each Time Point

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	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)
(0 – 40)	Main	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)
	t-test	*-0.014*	*0.294*	*0.480*	*0.774*	*0.235*	*-0.424*	*1.413*
CPS	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)
(0 – 6)	Main	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)
	t-test	*1.576*	*1.675*	*1.439*	*1.515*	*0.726*	***2.398****	***2.430****
ABS	GH	0.5 (1.1)	0.6 (1.2)	0.6 (1.3)	0.8 (1.4)	0.7 (1.3)	0.8 (1.3)	0.7 (1.2)
(0 – 12)	Main	0.4 (1.1)	0.4 (1.1)	0.4 (0.9)	0.4 (0.9)	0.4 (1.0)	0.5 (1.2)	0.4 (1.0)
	t-test	*0.379*	*1.504*	*1.269*	***2.267****	*1.697*	*1.451*	*1.029*
MSS	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)
(0 – 8)	Main	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)
	t-test	*1.633*	*1.228*	***3.472*****	***3.757*****	***4.177*****	***3.663*****	***2.192****
Number of	GH	93	93	93	76	64	51	37
assessments	Main	149	148	145	130	117	97	55

Note. ADL = activities of daily living; CPS = cognitive performance scale; ABS = aggressive behavior scale; MSS = mood scale score;
* p<0.05, ** p<0.01

Preparation for the Use of Latent Growth Curve Modeling (LGC)

Brief Review of LGC Modeling

Latent growth curve (LGC) modeling is a resourceful tool to analyze repeated measured data. LGC modeling regards change over time as an underlying latent process. In analyzing this process, a trajectory of change over time is estimated for each individual, and it is possible to identify the variables to make those different trajectories across individuals. They are presented in the form of parameters of slopes (sometimes quadratic changes) and intercepts, and treated as latent variables with the use of independent or dependent variables or covariates. LGC modeling 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).

Compared to other traditional methods that analyze repeated measured outcomes, LGC modeling can represent an advance over other traditional models and incorporate all of the advantages of mixed models for repeated measures (MMRM). LGC modeling has even more flexibility in covariance structures, which allows researchers to have more reasonable assumptions about the covariance or the residuals over time. Since it has been identified as an advantage of MMRM, LGC modeling also does not assume all individuals change at the same rate over time (i.e., some may change slower or faster). Because individuals change at different rates over time, the strength of correlations among the variables may change across time (Lawrence & Hancock, 1998). This flexibility is a great advantage of LGC modeling compared to a commonly used method, repeated measured ANOVA based on the sphericity assumption.

The advantageous flexibility of LGC modeling allows researchers to conduct two types of approaches: a variable-centered approach and person-centered approach. The variable-centered approach focuses on examining the relationships between variables. The main goal is to identify how independent variables influence dependent variables or to explore how constructs influence their observed indicators (Muthén & Muthén, 2000). This approach hypothesizes the homogeneity of a population, with the intention of generalizing the findings to the whole population. Specific statistical methods include regression and structural equation modeling (Poncheri & Ward, 2008). In contrast, the person-centered approach focuses on differences among individuals regarding the variable of interest, so the main purpose is to categorize individuals into groups; each group consists of individuals with similar characteristics from individuals in the other groups (Muthén & Muthén, 2000). The person-centered approach hypothesizes the heterogeneity of population making it necessary to create clusters within a population. For instance, cluster analysis, latent class analysis and latent transition analysis are included in the person-centered approach (Poncheri & Ward, 2008). Since LGC modeling is a special case of SEM with a longitudinal perspective, it is useful to predict trajectories (i.e., what participants' level on the variable of interest is and how it changes) and to identify how the other variables influence the trajectory. This is a common use of LGC modeling for the variable-centered approach; however, LGC modeling is flexible enough to be used for a person-centered approach by clustering people who share similar growth trajectories, which is growth mixture modeling.

In the LGC model, the intercept (i.e., initial status) and the rate of change (i.e., slope) are the variables of interest. The average slope and intercept are estimated based on the individual trajectories of the group in the model, which are fixed effects. However, since trajectories of individuals within the group may vary in terms of the means of slopes and intercepts, the variance of the mean intercept and mean slope can be estimated. Furthermore, linear LGC models can extend from linear change models to more complicated nonlinear changing models. Many statistical models for continuous outcomes are commonly based on the linearity assumption. However, in many medical or nursing studies regarding testing effects, the pattern of change over time may not be linear. For instance, the pattern may change more quickly at first, slow down or the opposite. Statistically, nonlinear models have more flexibility that can fit the relationship between the independent and dependent variables, and can improve the interpretability of the coefficients that are the constructs of primary interest. Although there are different types of non-linear models such as exponential or Gompertz, this study used a higher-order polynomial function (quadratic term) model. Nonlinear models may have more validity, which can restrict the form of relationships between variables within the theory, allowing for reasonable predictions (Pinheiro & Bates, 2000).

Regarding selecting the best fitting model, model fit indices commonly used in SEM can be used in LGC modeling, because LGC modeling is based on SEM. In this study, the model fit was assessed with the following commonly used fit indices in LGC modeling: chi-square statistics (X^2), comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean squared error of approximation (RMSEA), and adjusted Bayesian information criterion (BIC). The chi-square statistic is a fit index that can be used to gauge the match between a model`s prediction and observed data. If the model chi-square test is statistically significant, it means that it detects model-data discrepancy. This is, however, most likely to occur in a large sample size; thus, it is necessary to examine model fits with other indices (Kline, 2011). CFI and TLI are incremental fit indices which indicate whether one model is an improvement relative to the baseline model (Kaplan, 2009). If the values of CFI and TLI are close to 1, they indicate a better fit. The RMESA value represents model discrepancies taking into account errors of approximation in the population. A value below 0.05 indicates a good model fit, values between 0.05 and 0.08 are indicative of fair fit, and values between 0.08 and 0.10 are indicative of mediocre fit (Kaplan, 2009).

In summary, LGC modeling is more complicated than traditional approaches for outcome analysis. However, it is more flexible for building the models that researchers want to explore. As described above, LGC modeling can detect the differences of change over time between groups and estimate non-linear trajectories, so this method was selected for this study.

Handling of Missing data in Longitudinal Data

Almost all longitudinal studies inevitably have more missing data even in well-controlled conditions than cross-sectional studies because they require continuous participation at multiple assessments over time. Participants may miss at a particular point of measurement time or drop out of the study voluntarily or be lost to follow-up. The other participants may provide incomplete responses although they were assessed at a given study time point. This longitudinal study also had missing values during residents' stay or they may have dropped out due to the death or relocation to other facilities (Hedeker & Gibbons, 1997; Son, Friedmann, & Thomas, 2012).

Diagnosis of the Impact of Missingness on the Parameter Estimation

Recently, "pattern-mixture models" are used in the longitudinal studies to examine the effect of the missing-data pattern on the outcomes of interests because the usual missing-at-random assumption is too restrictive to apply to longitudinal data with dropouts (Hedeker & Gibbons, 1997). In addition, the repeated measured ANOVA utilizing only complete data may result in bias because participants completed study are likely to be healthy or less-vulnerable population, which may reduce the generalizability of findings. In the experimental design studies, if the missingness patterns that are informative are different between the intervention and comparison groups, the effectiveness of intervention can be decreased or increased by the bias. Thus, it is important to examine the possibility of missingness that is informative and to control for the effect of significant missingness patterns as covariates in the model (Son et al., 2012).

To conduct pattern-mixture models, participants need to be divided into several groups depending on their missing data patterns. Table 4.4 shows the types of missing data pattern of this longitudinal study data. In this study, in order to build a pattern-mixture model in a simpler way, participants were first classified into no missing data during their stay (n = 233), and missing data during their stay (n = 9) based on whether they had missingness during their stay. Then participants were classified into completers (i.e., stayed for 18 months) and dropouts (i.e., stayed more than 6 months but less than 18 months), which were coded as a dummy 0 (completers: reference group) and 1 (dropouts), respectively.

First, the "no missing data during the stay" group (n=233) was included to make an unconditional LGC model with a dummy variable examining the effect of dropouts prior to 18 months (146 dropouts vs. 87 completers) on the parameters to be estimated (i.e., three latent variables including the intercept, slope and quadratic term). However, since it is more important to assess whether the impact of dropouts is different between two types of facilities in the models, the interaction terms of facility type (either GH or Main home) and dropouts (completers or non-completers) were included in this pattern-mixture model.

Second, the same pattern-mixture model for all subjects (N=242, 150 dropouts vs. 92 completers) including the "missing data during the stay" group (n=9) was built and examined the impact of dropouts on the parameters to be estimated regardless of missing data during staying. The same interaction term was included to examine whether the impact of dropouts are different between two different facility types.

Table 4.4 Identification of Missing Data Patterns

	Time point							Number of residents		
	T1	T2	T3	T4	T5	T6	T7	GH	Main	**Total**
	No missing data during the stay (n = 233)									
Dropouts	O	O	O	X	X	X	X	16	18	146
	O	O	O	O	X	X	X	11	14	
	O	O	O	O	O	X	X	14	18	
	O	O	O	O	O	O	X	15	40	
Completers	O	O	O	O	O	O	O	33	54	87
	Missing data during the stay (n = 9)									
Dropouts	O	X	O	O	O	X	X	0	1	4
	O	O	X	O	O	X	X	0	1	
	O	O	X	O	O	O	X	0	1	
	O	O	X	X	O	O	X	0	1	
Completers	O	O	O	X	O	O	O	1	1	5
	O	O	O	O	X	O	O	2	0	
	O	O	O	O	O	X	O	1	0	
	Total							93	149	242

Note. N = frequency; O = not missing; X = missing

Table 4.5 shows the results of the pattern mixture models of the "no missing data during the stay" group (N = 233), which was built separately using four different outcome measures. The coefficients of the interaction term of facility type and dropouts were not significant in the all four different LGC models, indicating that there was no difference in the impact of dropouts before 18 months (i.e., non-completers) on the estimates of intercept, slope, and quadratic term by the two groups: GH home residents and Main home residents.

Table 4.6 shows the results of the pattern-mixture model of the whole participants (N = 242) including nine cases with missing values in the middle of the total period of stay. It also did not have any significant interaction terms of facility type and dropouts on the estimation of three latent variables in the four different outcome models. Based on these two steps of pattern-mixture models, it was possible to ignore the missing patterns including whether residents in this study 1) "dropped out before 18 months" (i.e., non-completers) and 2) "had missing values during the stay" in this study. Thus, all participants (N = 242) who had resided in the nursing homes at least six months regardless of their total length of stay were included when building the LGC models.

Table 4.5 Results of Pattern Mixture Models to Examine the Effect of Dropouts in the Group of No Missing Data during the Stay (N=233)

ADL	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	1.507	1.464	0.303	0.411	0.435	0.344	-0.070	0.057	0.218
Drop-outs	-0.459	1.288	0.722	-0.061	0.349	0.862	0.037	0.052	0.471
Group X Drop-outs	-2.209	1.885	***0.241***	-0.114	0.601	***0.850***	-0.047	0.093	***0.610***
CPS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.494	0.224	0.027	-0.059	0.086	0.496	0.015	0.013	0.276
Drop-outs	0.478	0.209	0.022	-0.056	0.077	0.462	0.013	0.014	0.355
Group X Drop-outs	-0.403	0.294	***0.169***	0.083	0.124	***0.503***	-0.013	0.124	***0.580***
ABS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.163	0.237	0.493	0.169	0.110	0.126	-0.027	0.017	0.122
Drop-outs	-0.115	0.178	0.520	0.130	0.092	0.156	-0.014	0.017	0.426
Group X Drop-outs	-0.211	0.289	***0.464***	-0.065	0.143	***0.651***	0.017	0.027	***0.517***
MSS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.500	0.390	0.200	0.191	0.225	0.396	-0.014	0.036	0.700
Drop-outs	0.193	0.241	0.422	0.025	0.179	0.890	-0.014	0.033	0.682
Group X Drop-outs	-0.316	0.485	***0.515***	0.272	0.337	***0.420***	-0.003	0.065	***0.961***

Note. ADL = activities of daily living; CPS = cognitive performance scale; ABS = aggressive behavior scale; MSS = mood scale score; SE = standard error.

Table 4.6 Results of Pattern Mixture Models to Examine the Effect of Dropouts in the Group with Missing Data during the Stay (N=242)

ADL	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	1.177	1.394	0.398	0.384	0.419	0.359	-0.061	0.056	0.275
Drop-outs	-0.422	1.258	0.737	-0.113	0.344	0.744	0.047	0.051	0.635
Group X Drop-outs	-1.981	1.821	***0.277***	-0.032	0.590	***0.957***	-0.068	0.092	***0.464***
CPS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.490	0.212	0.021	-0.089	0.084	0.286	0.022	0.013	0.104
Drop-outs	0.431	0.204	0.035	-0.044	0.075	0.558	0.011	0.014	0.449
Group X Drop-outs	-0.371	0.284	***0.191***	0.111	0.123	***0.368***	-0.019	0.024	***0.429***
ABS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.181	0.229	0.430	0.178	0.104	0.087	-0.028	0.016	0.089
Drop-outs	-0.122	0.174	0.483	0.129	0.090	0.148	-0.014	0.017	0.389
Group X Drop-outs	-0.214	0.281	***0.447***	-0.074	0.138	***0.592***	0.018	0.025	***0.476***
MSS	Intercept			Slope			Quadratic term		
Parameter	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Group	0.307	0.365	0.400	0.261	0.212	0.219	-0.023	0.034	0.495
Drop-outs	0.115	0.238	0.630	0.068	0.177	0.700	-0.019	0.033	0.561
Group X Drop-outs	-0.080	0.462	***0.862***	0.158	0.327	***0.629***	0.014	0.064	***0.830***

Note. ADL = activities of daily living; CPS = cognitive performance scale; ABS = aggressive behavior scale; MSS = mood scale score; SE = standard error.

Handling Missingness in the LGC Modeling Process

Missing-data mechanisms for all main outcome variables in this longitudinal study could be ignored. In addition, in the process of estimation, missing data were technically managed using full-information maximum likelihood (FIML) parameter estimation to obtain maximum likelihood (ML) parameter estimates with all of the 242 residents in the study sample. FIML is often preferred in LGC modeling since it uses all available information to estimate parameters, and does not require an extremely large sample (Preacher et al., 2008).

Handling Data Dependency at the Unit Level

In this study, residents were clustered within a nursing home unit. Because it is necessary to consider a nested data structure in terms of a more valid estimation of standard errors of parameters through a sandwich (robust) estimation process (Snijders & Bosker, 1999), this study considered a multi-level data structure (i.e., residents nested in the unit). When using the Mplus software, the robust maximum likelihood (MLR) estimation option was used to address the clustered data (i.e., cluster = unit, type = complex, and estimator = MLR).

LGC Modeling Processes and Results

The main research question was to compare changes in patterns of health status (ADL, cognitive function, behavioral problems and mood) in the two groups, GH home residents and traditional nursing home residents controlling for age and gender. In order to answer these questions, three main steps were taken to build four different outcome models separately: 1) build basic growth trajectories (unconditional LGC models); 2) add a group dummy to test the group effect (i.e., facility type whether GH or traditional nursing homes) on the estimation of growth trajectories (conditional LGC models); and 3) add covariates to control for residents' covariates in the second step models (conditional LGC models). Table

4.7 shows the simplified steps and which variables were included in the models. Specific results from each step in the model building process are described below.

Table 4.7 Variables Included to Each Step of Analysis

Category	Variables	Step 1 Unconditional	Step 2 Conditional model	Step 3
Outcome variable	ADL	X	X	X
	Cognitive function	X	X	X
	Aggressive behaviors	X	X	X
	Negative mood	X	X	X
Independent variable	Facility type (GH or Main homes)		X	X
Covariates	Age			X
	Gender			X

Note. Higher scores of four outcome variables indicate poor functioning or more negative symptoms.

Step 1: Unconditional LGC Model

First, unconditional models are growth models that represent trajectories of resident's health status without controlling for any variables. These models are used to identify the general form of change in health outcomes over time. The LGC model is a variable-centered model, which is individuals are assumed to come from one population and a mean growth curve is estimated using all the individual trajectories. Individual trajectories for each health outcome were derived from observed scores at seven time points: baseline (T1), 3 months (T2), 6 months (T3), 9 months (T4), 12 months (T5), 15 months (T6), and 18 months (T7). Since these longitudinal data have seven points of time, it was enough to develop quadratic models, which is a non-linear model. With these seven observed data points, three latent variables were derived in the LGC models: the intercept, slope, and quadratic term. (See Figure 4.1.) The intercept (I) is an estimated mean for the individual trajectories at baseline; the slope (S) is an estimated mean for the rate of linear change of the individual trajectories over time; and the quadratic term (Q) is an estimated mean for the quadratic acceleration or deceleration of the rate of change. In addition to the all of the sample models, two separate models by group (i.e., GH home residents and Main home residents) were built.

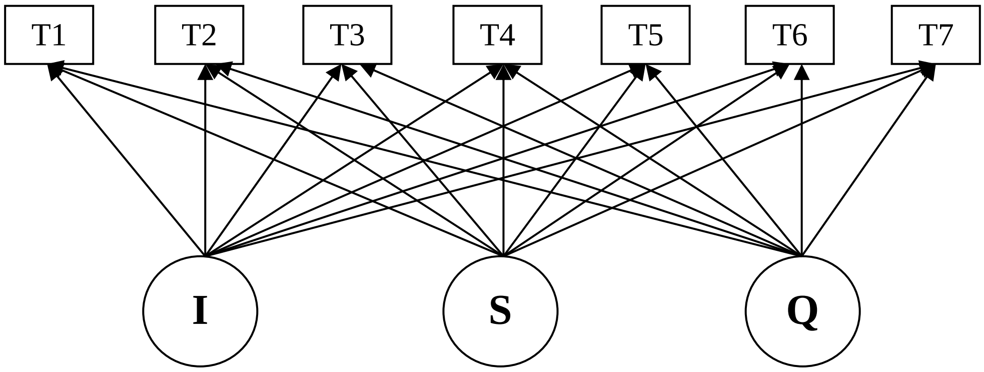


Figure 4.1 Basic LGC Model (unconditional model)
Note. T = Time point, I = Intercept, S = Slope, Q = Quadratic term

1) ADL function

The LGC model using for ADL trajectory was a good fit. (See Table 4.8.) The overall growth curve of ADL in all 242 nursing home residents showed that ADL function became significantly worse in a linear pattern over time, indicating an increasing ADL long-term scale score (slope = 0.570, p-value = 0.000). (See Table 4.9.) Higher scores of ADL long-term scale score indicate worse ADL function. In terms of the two group models (separate models by facility type), the growth curves of ADL in GH homes and Main homes had positive rates of change for ADL trajectories without a significant deceleration or acceleration (slope in GH = 0.741 and p-value = 0.002, slope in Main = 0.463 and p-value = 0.000). (See Table 4.11.) This means that residents' ADL function was reported to be decline in a linear pattern in both groups, although the estimated values of the slope looked different between the two groups.

Table 4.8 Model Fit Statistics for ADL Trajectory (all participants)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
All	242	39.080/19	0.0043	0.996	0.995	0.066	0.035

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.9 Estimates of Intercept, Slope, and Quadratic Term for ADL Trajectory (all participants)

Parameter	Estimate	SE	p-value	CI (95%)
Intercept	**14.346**	**1.295**	**0.000****	**(11.809;16.883)**
Slope	**0.570**	**0.115**	**0.000****	**(0.344;0.796)**
Quadratic	-0.028	0.017	0.092	(-0.055;0.005)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

Table 4.10 Model Fit Statistics for ADL Trajectory (two groups)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
GH	93	46.366/19	0.0004	0.985	0.983	0.124	0.043
Main home	149	33.218/19	0.0227	1.000	1.000	0.071	0.039

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.11 Estimates of Intercept, Slope, and Quadratic Term for ADL Trajectory (two groups)

	GH home residents				Main home residents			
Parameter	Estimate	SE	p-value	CI (95%)	Estimate	SE	p-value	CI (95%)
Intercept	**14.413**	**1.272**	**0.000****	**(11.919;16.906)**	**14.329**	**1.931**	**0.000****	**(10.543;18.114)**
Slope	**0.741**	**0.238**	**0.002****	**(0.274;1.208)**	**0.463**	**0.109**	**0.000****	**(0.250;0.675)**
Quadratic	-0.069	0.036	0.058	(-0.140;0.002)	-0.003	0.009	0.713	(-0.018;0.014)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

2) Cognitive function

The whole sample model showed that the mean cognitive function had no significant changes over time regarding the slope (slope = 0.045, p-value = 0.054) and quadratic term (quadratic term = 0.003, p-value = 0.559), which means that the average cognitive function was quite stable over time despite a good model fit. (See Table 4.12 & 4.13.) Higher scores of CPS indicate worse cognitive function. In the two separate models for CPS trajectories, the mean trajectories of CPS in both groups showed quite stable patterns. However, GH home residents' cognitive function was reported to be significantly accelerated in terms of the rate of change over time, while the Main home residents had no significant changes over time in the linear and quadratic patterns over time. (See Table 4.15.)

Table 4.12 Model Fit Statistics for CPS Trajectory (all participants)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
All	242	57.739/19	0.0000	0.914	0.905	0.092	0.048

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.13 Estimates of Average Intercept, Slope, and Quadratic Term for CPS Trajectory (all participants)

Parameter	Estimate	SE	p-value	CI (95%)
Intercept	**2.349**	**0.173**	**0.000****	**(2.010;2.687)**
Slope	0.045	0.024	0.054	(-0.001;0.092)
Quadratic	0.003	0.005	0.559	(-0.0075;0.013)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

Table 4.14 Model Fit Statistics for CPS Trajectory (two groups)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
GH	93	53.430/19	0.0000	0.828	0.810	0.140	0.079
Main home	149	58.512/19	0.0000	0.931	0.923	0.118	0.041

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.15 Estimates of Average Intercept, Slope, and Quadratic Term for CPS Trajectory (two groups)

	GH home residents				Main home residents			
Parameter	Estimate	SE	p-value	CI (95%)	Estimate	SE	p-value	CI (95%)
Intercept	**2.521**	**0.179**	**0.000****	**(2.170;2.872)**	**2.243**	**0.249**	**0.000****	**(1.602; 2.730)**
Slope	0.017	0.015	0.257	(-0.013;0.047)	0.064	0.035	0.066	(-0.026; 0.131)
Quadratic	**0.012**	**0.006**	**0.026***	**(0.001;0.023)**	-0.003	0.006	0.675	(-0.018; 0.009)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

3) Aggressive behavior symptoms

The whole sample model showed that the mean ABS did not significantly change over time in the linear and quadratic patterns despite a good model fit, which means that the average growth curve of ABS was quite stable over time. (See Table 4.17.) In the two group models, while the growth curve of ABS in Main homes had no significant change over time like whole sample model, residents in GH homes showed a significant positive rate of change over time (slope = 0.107, p-value = 0.022). (See Table 4.19.) This means that residents' aggressive behavior symptoms in GH homes were reported to increase in a linear pattern.

Table 4.16 Model Fit Statistics for ABS Trajectory (all participants)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
All	242	30.133/19	0.0501	0.973	0.970	0.049	0.056

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.17 Estimates of Average Intercept, Slope, and Quadratic Term for ABS Trajectory (all participants)

Parameter	Estimate	SE	p-value	CI (95%)
Intercept	**0.428**	**0.090**	**0.000****	**(0.251; 0.605)**
Slope	0.022	0.029	0.444	(-0.034; 0.078)
Quadratic	0.000	0.006	0.993	(-0.012; 0.012)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

Table 4.18 Model Fit Statistics for ABS Trajectory (two groups)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
GH	93	56.366/19	0.0000	0.822	0.803	0.145	0.095
Main home	149	22.680/19	0.2517	0.994	0.993	0.036	0.078

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.19 Estimates of Average Intercept, Slope, and Quadratic Term for ABS Trajectory (two groups)

	GH home residents				Main home residents			
Parameter	Estimate	SE	p-value	CI (95%)	Estimate	SE	p-value	CI (95%)
Intercept	**0.464**	**0.140**	**0.001****	**(0.189;0.738)**	**0.407**	**0.118**	**0.001****	**(0.176;0.638)**
Slope	**0.107**	**0.047**	**0.022***	**(0.015;0.199)**	-0.036	0.023	0.112	(-0.080;0.008)
Quadratic	-0.012	0.009	0.191	(-0.030;0.006)	0.009	0.007	0.187	(-0.004;0.021)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

4) Negative mood symptoms

The mean of depressive symptoms in the 242 residents in both nursing homes significantly increased in a linear pattern over time (slope = 0.290, p-value = 0.004). See Table 4.21.) However, when the two group models were built separately, only the GH home group had a significant change of mood scores over time in linear as well as quadratic patterns. Specifically, the average of the mood scores was reported to increase over time (slope = 0.561, p-value = 0.000), but its rate of change decelerated (quadratic term = -0.053, p-value = 0.010) in GH home residents. However, Main home residents had no significant change of mood scores over time (See Table 4.23.)

Table 4.20 Model Fit Statistics for MSS Trajectory (all participants)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
All	242	41.750/19	0.0019	0.958	0.954	0.070	0.062

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.21 Estimates of Average Intercept, Slope and Quadratic Term for MSS Trajectory (all participants)

Parameter	Estimate	SE	p-value	CI (95%)
Intercept	**0.908**	**0.198**	**0.000****	**(0.521;1.295)**
Slope	**0.290**	**0.100**	**0.004****	**(0.094;0.486)**
Quadratic	-0.027	0.015	0.063	(-0.056;0.001)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

Table 4.22 Model Fit Statistics for MSS Trajectory (two groups)

Group	N	X^2/df	p-value	CFI	TLI	RMSEA	SRMR
GH	93	45.343/19	0.0006	0.889	0.877	0.122	0.093
Main home	149	43.741/19	0.0010	0.937	0.931	0.093	0.091

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.23 Estimates of Average Intercept, Slope, and Quadratic Term for MSS Trajectory (two groups)

	GH home residents				Main home residents			
Parameter	Estimate	SE	p-value	CI (95%)	Estimate	SE	p-value	CI (95%)
Intercept	**1.031**	**0.320**	**0.001****	**(0.405; 1.657)**	**0.809**	**0.232**	**0.000****	**(0.354; 1.264)**
Slope	**0.561**	**0.150**	**0.000****	**(0.268; 0.855)**	0.132	0.086	0.126	(-0.037; 0.302)
Quadratic	**-0.053**	**0.021**	**0.010***	**(-0.094; -0.013)**	-0.012	0.016	0.425	(-0.043; 0.018)

Note. SE = standard error; CI = 95% confidence interval; * p<0.05, ** p<0.01.

Step 2: LGC Model to Examine the Group Effect

The second step was to add an independent variable to the unconditional LGC model to create the conditional LGC model. The main independent variable, facility type (i.e., GH resident or Main home resident) was added as a dummy in order to examine the impact of different facility types on the three latent variables: intercept, slope, and quadratic term. The group effects on the estimated latent variables are represented by βs. Specifically, for the group effect on the intercept, the initial status is represented by β_{11}: for the group effect on the slope, the linear rate of change is β_{21}: and for the group effect on the quadratic term whether acceleration or deceleration of the rate of change is β_{31} (See Figure 4.2.)

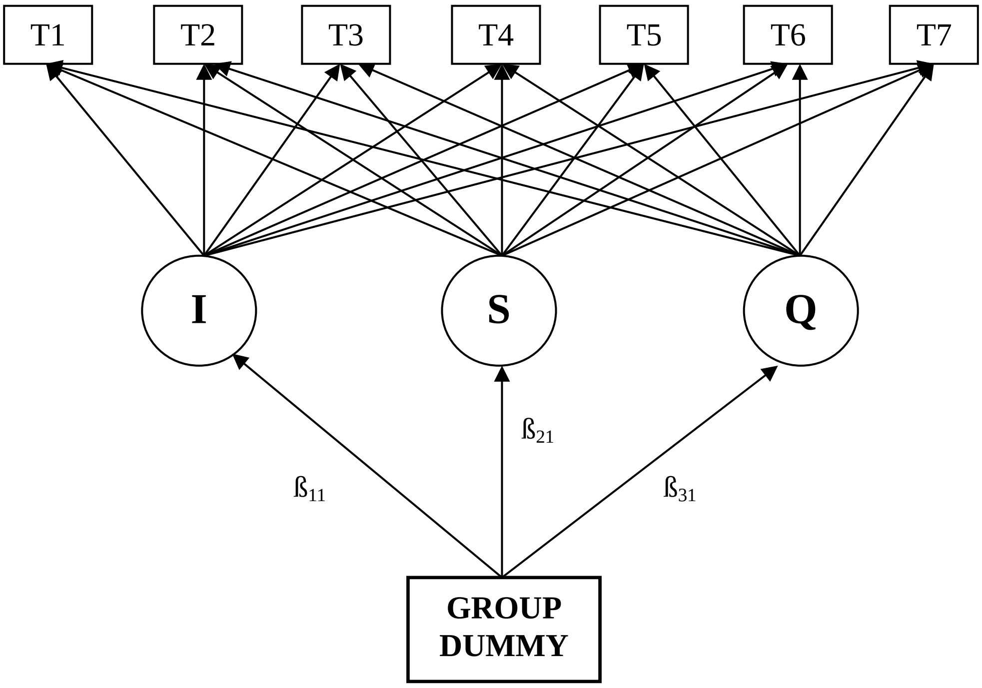


Figure 4.2 LGC model with a group dummy (conditional model)

Note. T = Time interval, I = Intercept, S = Slope, Q = Quadratic term

1) ADL function

The conditional model with a group dummy of the ADL function variable had a good fit. (See Table 4.24.) Table 4.25 presents the group effects (i.e., the effect of GH homes compared to Main homes) on the three latent variables including intercept, slope and quadratic term. The reference group (i.e., Main group residents) reported a significant decline of ADL function in a linear pattern over time (slope = 0.484, p-value = 0.007), but the change pattern was not significantly different from the reports of GH residents in terms of the initial status ($ß_{11}$ = 0.078, p-value = 0.973), linear rate of change ($ß_{21}$ = 0.229, p-value = 0.373) or acceleration/deceleration of slope ($ß_{31}$ = -0.059, p-value = 0.165) of the ADL function over time. As Figure 4.3 reveals, the blue line (i.e., GH home residents' mean trajectory) and red line (i.e., Main home residents' mean trajectory) looked somewhat different, but their differences in terms of the intercept, slope and quadratic term were not at the statistical levels. Both groups showed significant decline of ADL function over time.

Table 4.24 Model Fit Statistics for ADL Trajectory with a Group Dummy

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	46.201/23	0.0028	0.992	0.990	0.065	0.034

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.25 Results of the Group Effect on Intercept, Slope, and Quadratic Term for ADL Trajectory

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	14.315	1.922	0.000**	(10.548;18.082)
Slope	0.484	0.110	0.000**	(0.268;0.701)
Quadratic	-0.007	0.011	0.570	(-0.029;0.016)
Group effect	Estimate	SE	p-value	CI
$ß_{11}$	0.078	2.292	0.973	(-4.414;4.570)
$ß_{21}$	0.229	0.257	0.373	(-0.433;0.732)
$ß_{31}$	-0.059	0.042	0.165	(-0.168;0.024)

Note. # = reference group in this study is Main home residents; SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

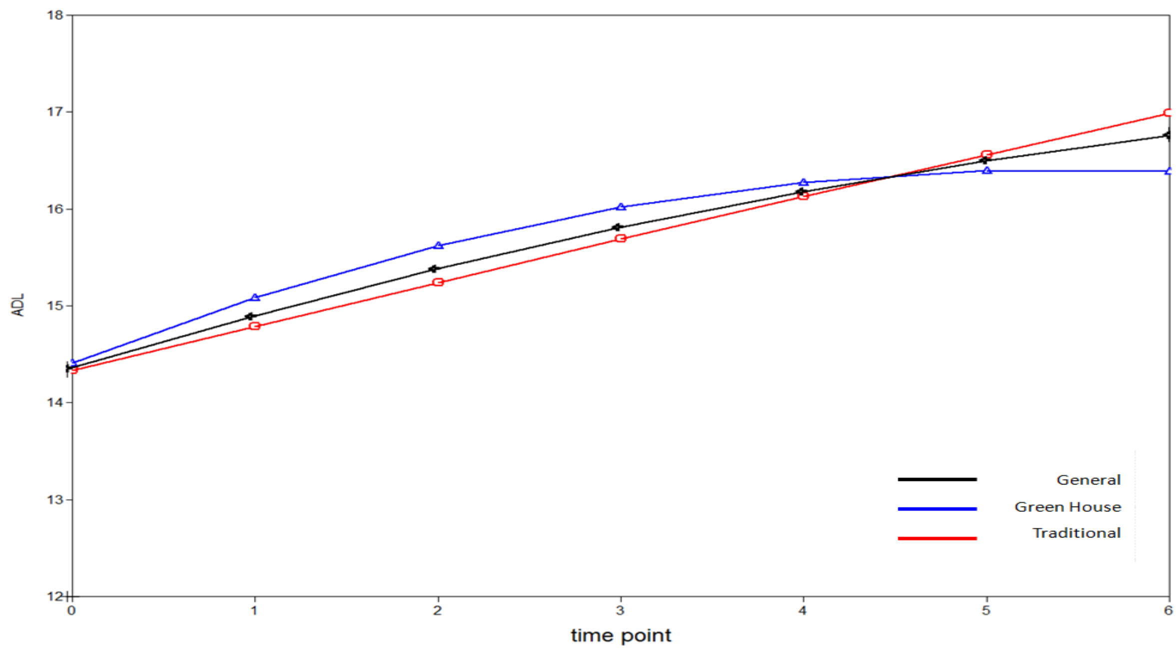


Figure 4.3 Mean ADL trajectories

Note. The black line is a mean ADL trajectory for all subjects; the blue and red lines are mean ADL trajectories of GH residents and Main home residents, respectively; higher scores of ADL indicate worse ADL function.

2) Cognitive function

With a moderate model fit, the conditional model of CPS with a group dummy variable showed that there was no group effect between GH home residents and Main home residents in terms of the initial cognitive function ($ß_{11}$ = 0.271, p-value = 0.383), linear rate of change ($ß_{21}$ = -0.044, p-value = 0.214), or acceleration/deceleration of the slope of CPS ($ß_{31}$ = 0.015, p-value = 0.069) over time. (See Table 4.26 & 4.27.) The mean cognitive function in the reference group of Main home residents was quite stable over time, which was not a different pattern from those of GH home residents. As Figure 4.4 shows, both the blue and red lines do not have a dominant change pattern over time. Although the blue line (i.e., GH home residents' mean trajectory) shows some acceleration of the pattern, it was not a significant level in terms of the group effect on the quadratic term in the model.

Table 4.26 Model Fit Statistics for CPS Trajectory with a Group Dummy

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	66.517/23	0.0000	0.918	0.900	0.088	0.043

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.27 Results of the Group Effect on Intercept, Slope, and Quadratic Term for CPS Trajectory

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	2.244	0.251	0.000**	(1.753;2.657)
Slope	0.063	0.034	0.065	(-0.004;0.119)
Quadratic	-0.003	0.006	0.608	(-0.014;0.007)
Group effect	Estimate	SE	p-value	CI
$ß_{11}$	0.271	0.310	0.383	(-0.337;0.879)
$ß_{21}$	-0.044	0.035	0.214	(-0.113;0.025)
$ß_{31}$	0.015	0.008	0.069	(-0.001;0.032)

Note. # = reference group in this study is Main home residents; SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

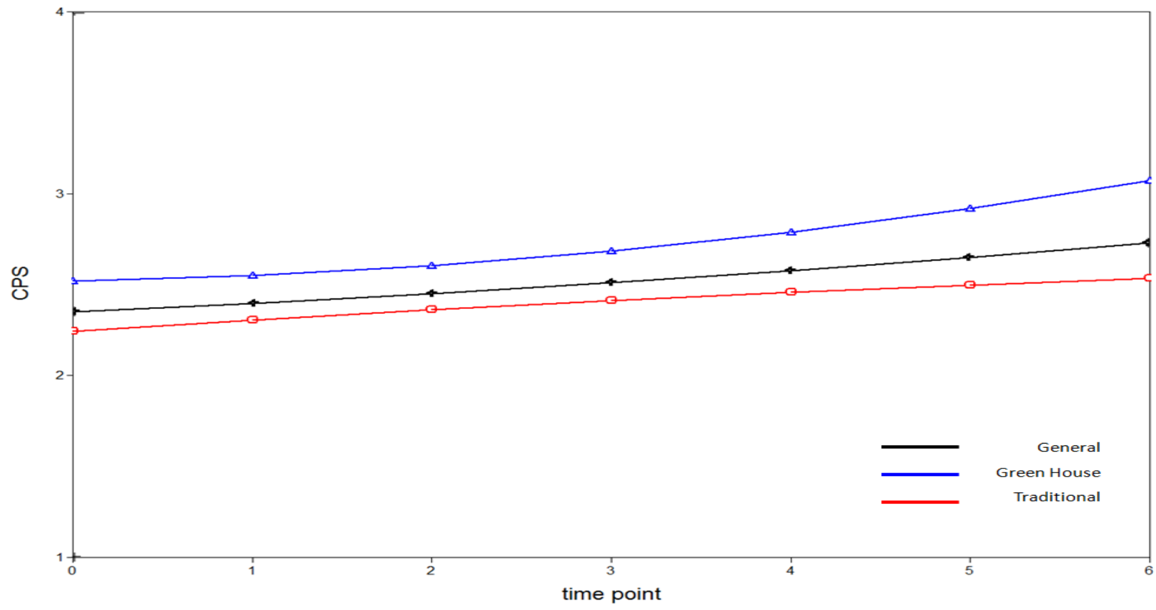


Figure 4.4 Mean CPS trajectories

Note. The black line is a mean CPS trajectory for all subjects; the blue and red lines are mean CPS trajectories of GH residents and Main home residents, respectively; higher scores of CPS indicate worse cognitive function.

3) Aggressive behavior symptoms

The conditional model of ABS with a group dummy variable was a good fit as Table 4.28 indicates. In the model with the group dummy variable, the group effect coefficients of slope ($ß_{21}$ = 0.148, p-value = 0.004) and quadratic term ($ß_{31}$ = -0.022, p-value = 0.040) were significant. Compared to the quite stable pattern of the reference group of the Main home residents (i.e., the means of slope and quadratic term of the reference group were not statistically significant), the aggressive behaviors in the GH homes was reported to increase in a higher linear rate of change despite deceleration of the slope over time. (See Table 4.29.)

Table 4.28 Model Fit Statistics for ABS Trajectory with a Group Dummy

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	34.337/23	0.0604	0.975	0.970	0.045	0.051

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.29 Results of the Group Effect on Intercept, Slope, and Quadratic Term for ABS Trajectory

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	0.406	0.117	0.001**	(0.105;0.635)
Slope	-0.035	0.019	0.073	(-0.084;0.003)
Quadratic	0.008	0.006	0.153	(-0003;0.020)
Group effect	Estimate	SE	p-value	CI
$ß_{11}$	0.056	0.183	0.758	(-0.302;0.414)
$ß_{21}$	**0.148**	**0.051**	**0.004****	**(0.047;0.249)**
$ß_{31}$	**-0.022**	**0.011**	**0.040***	**(-0.042;-0.001)**

Note. # = reference group in this study is Main home residents; SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

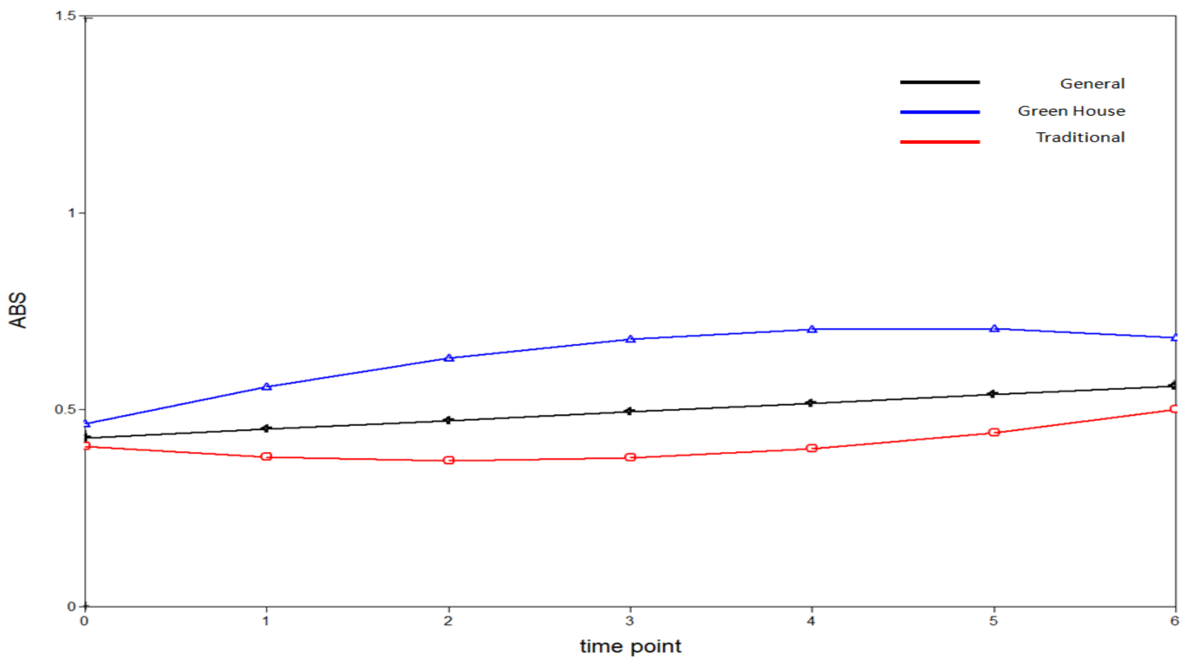


Figure 4.5 Mean ABS trajectories

Note. The black line is a mean ABS trajectory for all subjects; the blue and red lines are mean ABS trajectories of GH residents and Main home residents, respectively; higher scores of ABS indicate more reports of aggressive behaviors.

4) Negative mood symptoms

As Table 4.30 shows, the conditional model of MSS with group dummy variable was a good to fair fit. The averages of the slope and quadratic term in Main home residents, which were stable over time, were not significant (mean of slope = 0.134, p-value = 0.115; mean of quadratic term = -0.013, p-value = 0.420). In terms of the group effect on the latent variables, although initial negative mood symptoms were not different between the two groups ($ß_{11}$ = 0.241, p-value = 0.552), the coefficient of the group effect on the slope was significant ($ß_{21}$ = 0.417, p-value = 0.019). (See Table 4.31.) This means that the linear rate of change was significantly higher in the GH home group compared to the Main home group. The quadratic term was likely to show more deceleration but it was not a statistically significant level ($ß_{31}$ = -0.037, p-value = 0.129). As Figure 4.6 shows, the blue line (i.e., GH home residents) distinctly shows a higher slope of the report of negative mood despite some deceleration of the slope over time.

Table 4.30 Model Fit Statistics for MSS Trajectory with a Group Dummy

Group	N	X2	p	CFI	TLI	RMSEA	SRMR
All	242	48.714/23	0.0014	0.955	0.946	0.068	0.060

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.31 Results of the Group Effect on Intercept, Slope, and Quadratic Term for MSS Trajectory

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	0.812	0.232	0.000**	(0.357;1.194)
Slope	0.134	0.085	0.115	(-0.033;0.274)
Quadratic	-0.013	0.016	0.420	(-0.045;0.014)
Group effect	Estimate	SE	p-value	CI
$ß_{11}$	0.241	0.405	0.552	(-0.553;1.035)
$ß_{21}$	**0.417**	**0.178**	**0.019***	**(0.069;0.765)**
$ß_{31}$	-0.037	0.025	0.129	(-0.086;0.011)

Note. # = reference group in this study is Main home residents; SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

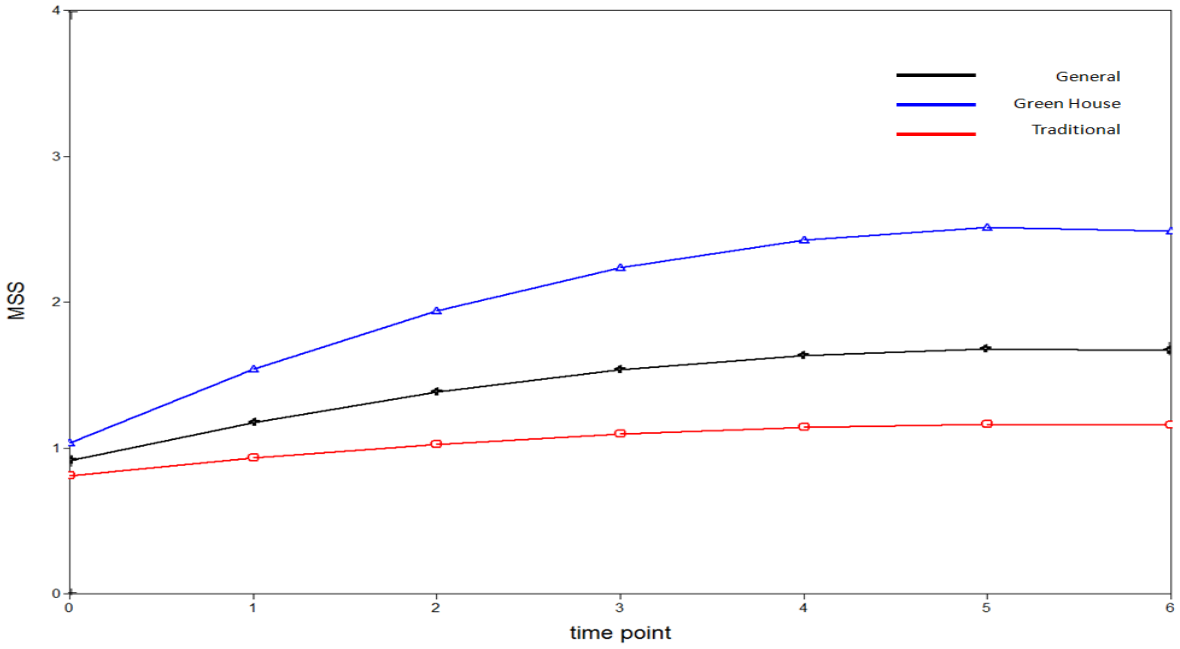


Figure 4.6 Mean MSS trajectories

Note. The black line is a mean MSS trajectory for all subjects; the blue and red lines are mean MSS trajectories of GH residents and Main home residents, respectively; Higher scores of MSS indicate more reports of negative mood.

Step 3: LGC Model to Examine the Group Effect Controlling for Covariates

Based on the conditional model with a group dummy variable in the second step, two covariates including age and gender were added in the final third step. All of these predictors were treated as time-invariant covariates, in which they consistently influence factor estimates of intercepts, slopes, or quadratic terms of health outcomes. The group effects and effects of covariates on the estimated latent variables are represented by βs. Specifically, 1) the group effect on the intercept, slope and quadratic term are represented by β_{11}, β_{21} and β_{31}, respectively; 2) the effects of age on the intercept, slope, and quadratic term are represented by β_{12}, β_{22} and β_{32}; and 3) the effects of gender on the intercept, slope and quadratic term are represented by β_{13}, β_{23} and β_{33}.

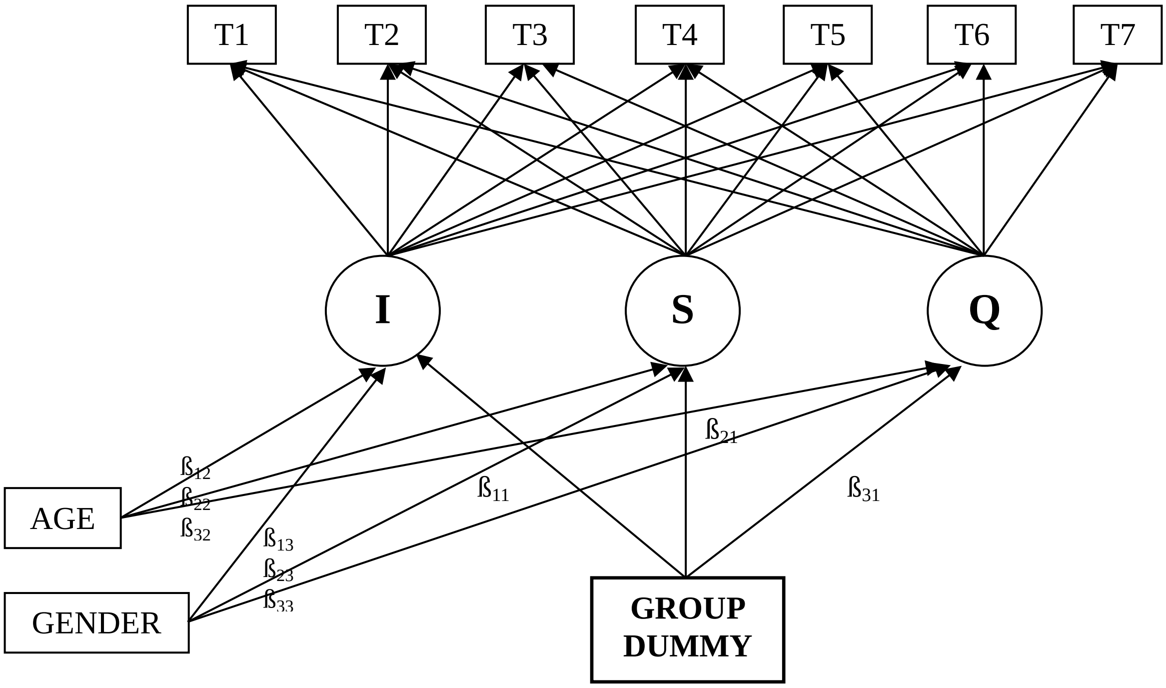


Figure 4.7 LGC model with a group dummy and covariates (conditional model)

Note. T = time interval, I = intercept, S = slope, Q = quadratic term

1) ADL function

The conditional model of ADL function with covariates examining the group effect had a good fit (See Table 4.32.) Table 4.33 presents the group effects (i.e., GH homes or Main homes) on the three latent variables of intercept, slope, and quadratic term controlling for age and gender. After controlling for age and gender, there was no group difference between the two groups in terms of the initial status ($ß_{11}$ = 0.172, p-value = 0.939), the linear rate of change ($ß_{21}$ = 0.271, p-value = 0.292) and acceleration/deceleration of the rate of change ($ß_{31}$ = -0.074, p-value = 0.075) of the ADL function change. Regardless of controlling for age and gender, overall findings in this model are similar with those in the second model without covariates. Regarding the effect of the covariates, gender significantly influenced the quadratic term of the ADL function trajectory ($ß_{13}$ = -0.090, p-value = 0.018), which means that the change pattern of ADL function in women was a more decelerated rate of change over time than men.

Table 4.32 Model Fit Statistics for LGC Model with Covariates for ADL Trajectory

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	56.958/31	0.0030	0.991	0.998	0.059	0.029

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.33 Results of the Group Effect on Intercept, Slope, and Quadratic Term for ADL Trajectory with Covariates

Means of reference group[#]	Estimate	SE	p-value	CI (95%)
Intercept	14.244	2.430	0.000**	(9.481;19.008)
Slope	0.275	0.302	0.362	(-0.316;0.867)
Quadratic	0.071	0.031	0.022*	(0.010;0.131)
Group	Estimate	SE	p-value	CI
(I) $ß_{11}$	0.172	2.244	0.939	(-4.227;4.571)
(S) $ß_{21}$	0.271	0.257	0.292	(-0.233;0.775)
(Q) $ß_{31}$	-0.074	0.041	0.075	(-0.155;0.007)
Age	Estimate	SE	p-value	CI
(I) $ß_{12}$	-0.081	0.044	0.067	(-0.168;0.006)
(S) $ß_{22}$	0.003	0.009	0.791	(-0.016;0.021)
(Q) $ß_{32}$	0.001	0.002	0.473	(-0.002;0.004)
Gender	Estimate	SE	p-value	CI
(I) $ß_{13}$	0.055	1.131	0.961	(-2.161;2.271)
(S) $ß_{23}$	0.239	0.340	0.483	(-0.428;0.905)
(Q) $ß_{33}$	-0.090	0.038	0.018*	(-0.164;-0.015)

Note. [#] = the reference group in this study is residents who are the mean age (age = 86.31) male (gender = 0) in Main homes (group = 0); SE = standard error; CI = confidence interval; * $p<0.05$, ** $p<0.01$.

2) Cognitive function

The conditional LGC model of CPS revealed that there was no group effect on the three latent variables, intercept ($ß_{11}$ = 0.246, p-value = 0.394), slope ($ß_{21}$ = -0.043, p-value =

0.270), and quadratic term ($ß_{31}$ = 0.015, p-value = 0.111) of cognitive function change over time controlling for age and gender. Even after controlling for age and gender, the finding of no group differences between GH home residents and Main home residents on their cognitive function trajectory did not change from those reported in the second step conditional model without covariates (See Table 4.35.) Regarding the effects of the covariates on the model, gender significantly influenced the intercept of CPS ($ß_{13}$ = -0.472, p-value = 0.002), which means that women reported better cognitive function than men at admission.

Table 4.34 Model Fit Statistics for LGC Model with Covariates for CPS Trajectory

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	82.694/31	0.0000	0.928	0.902	0.083	0.037

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.35 Results of the Group Effect on Intercept, Slope and Quadratic Term for CPS Trajectory with Covariates

Means of reference group[#]	Estimate	SE	p-value	CI (95%)
Intercept	2.601	0.302	0.000**	(2.009;3.193)
Slope	0.078	0.041	0.057	(-0.002;0.158)
Quadratic	-0.006	0.010	0.554	(-0.026;0.014)
Group	Estimate	SE	p-value	CI
(I) $ß_{11}$	0.246	0.288	0.394	(-0.319; 0.810)
(S) $ß_{21}$	-0.043	0.039	0.270	(-0.119; 0.033)
(Q) $ß_{31}$	0.015	0.009	0.111	(-0.003; 0.033)
Age	Estimate	SE	p-value	CI
(I) $ß_{12}$	0.015	0.006	0.010	(0.004; 0.026)
(S) $ß_{22}$	0.000	0.005	0.949	(-0.009; 0.010)
(Q) $ß_{32}$	0.000	0.001	0.975	(-0.002; 0.002)
Gender	Estimate	SE	p-value	CI
(I) $ß_{13}$	-0.472	0.150	0.002*	(-0.766; -0.177)
(S) $ß_{23}$	-0.022	0.044	0.622	(-0.108; 0.065)
(Q) $ß_{33}$	0.005	0.010	0.643	(-0.016; 0.025)

Note. [#] = the reference group in this study is residents who are the mean age (age = 86.31) male (gender = 0) in Main homes (group = 0); SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

3) Aggressive behavior symptoms

With a good model fit, the conditional aggressive behavior symptom model with covariates showed that there was a group effect on two latent variables, slope ($ß_{21}$ = 0.158, p-value = 0.003), and quadratic term ($ß_{31}$ = -0.025, p-value = 0.027) despite no significance difference of in intercept. (See Table 4.37.) This means that GH home residents showed a higher linear rate of ABS deterioration with more significant deceleration over time compared to the Main home residents who showed a stable pattern. These findings from the LGC model with covariates were also similar to those previously revealed in the second step conditional model of ABS without covariates. Among the two covariates, gender significantly influenced the intercept latent variable ($ß_{13}$ = -0.590, p-value = 0.004), which means fewer aggressive behavior symptoms were reported in the group of women than men at admission.

Table 4.36 Model Fit Statistics for LGC Model with Covariates for ABS Trajectory

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	46.502/31	0.0597	0.975	0.968	0.041	0.045

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.37 Results of the Group Effect on Intercept, Slope, and Quadratic Term for ABS Trajectory with Covariates

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	0.840	0.239	0.001**	(0.371;1.310)
Slope	-0.108	0.058	0.062	(-0.222;0.006)
Quadratic	0.021	0.013	0.094	(-0.004;0.046)
Group	Estimate	SE	p-value	CI (95%)
(I) $ß_{11}$	0.056	0.187	0.765	(-0.311;0.423)
(S) $ß_{21}$	**0.158**	**0.053**	**0.003****	**(0.053;0.263)**
(Q) $ß_{31}$	**-0.025**	**0.011**	**0.027***	**(-0.048;-0.003)**
Age	Estimate	SE	p-value	CI (95%)
(I) $ß_{12}$	-0.004	0.005	0.443	(-0.013;0.006)
(S) $ß_{22}$	-0.001	0.003	0.747	(-0.006;0.004)
(Q) $ß_{32}$	0.001	0.000	0.118	(0.000;0.001)
Gender	Estimate	SE	p-value	CI (95%)
(I) $ß_{13}$	-0.590	0.203	0.004**	(-0.987;-0.192)
(S) $ß_{23}$	0.090	0.071	0.204	(-0.049;0.229)
(Q) $ß_{33}$	-0.013	0.012	0.264	(-0.037;0.010)

Note. # = the reference group in this study is residents who are the mean age (age = 86.31) male (gender = 0) in Main homes (group = 0); SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

4) Negative mood symptoms

As Table 4.38 shows, the conditional model of MSS with a group variable and covariates was a good to fair fit. In terms of the group effect on the latent variables, the coefficients of group on the intercept and slope were significant ($ß_{11}$ = 0.228, p-value = 0.011 and $ß_{21}$ = 0.468, p-value = 0.014, respectively) but those on the quadratic term were not. While the initial mood scores between two groups were not statistically different in the second model without covariates, this third model controlling for age and gender identified that initial mood scores in GH home residents were reported to be worse than those in Main home residents at admission. Furthermore, compared to the stable mood pattern over time in Main home residents (i.e., not significant means of slope and quadratic term in the reference group), the coefficient of group effects on the slope of mood score was significant. Both findings mean that GH home residents were rated as more negative mood symptoms at admission and increasing rate of change of negative mood symptoms over time than Main home residents. (See Table 4.39.) Regarding the effect of covariates, gender influenced two latent variables, slope and quadratic term in this MSS model, with negative mood symptoms in women were reported increasing linear rate of change compared to men although the rate of change significantly decelerated over time.

Table 4.38 Model Fit Statistics for LGC Model with Covariates for MSS Trajectory

Group	N	X^2/df	p	CFI	TLI	RMSEA	SRMR
All	242	61.000/31	0.0010	0.952	0.935	0.063	0.055

Note. N = sample size; df = degree of freedom; CFI = comparative fit index; TLI = Tucker-Lewis Index; RMSEA = standardized root mean square residual; SRMR = root mean square error of approximation.

Table 4.39 Results of the Group Effect on Intercept, Slope, and Quadratic Term for MSS Trajectory with Covariates

Means of reference group#	Estimate	SE	p-value	CI (95%)
Intercept	0.864	0.316	0.006*	(0.244;1.484)
Slope	-0.118	0.149	0.427	(-0.410;0.173)
Quadratic	0.044	0.030	0.135	(-0.014;0.102)
Group	Estimate	SE	p-value	CI
(I) $ß_{11}$	**0.228**	**0.403**	**0.011***	**(-0.561;1.017)**
(S) $ß_{21}$	**0.468**	**0.190**	**0.014***	**(0.104;0.810)**
(Q) $ß_{31}$	-0.048	0.026	0.063	(-0.098;0.003)
Age	Estimate	SE	p-value	CI
(I) $ß_{12}$	0.007	0.012	0.573	(-0.016;0.029)
(S) $ß_{22}$	-0.012	0.009	0.160	(-0.029;0.005)
(Q) $ß_{32}$	0.002	0.001	0.102	(0.000;0.005)
Gender	Estimate	SE	p-value	CI
(I) $ß_{13}$	-0.057	0.193	0.768	(-0.434;0.321)
(S) $ß_{23}$	0.303	0.146	0.038*	(0.017;0.590)
(Q) $ß_{33}$	-0.067	0.027	0.012*	(-0.119;-0.015)

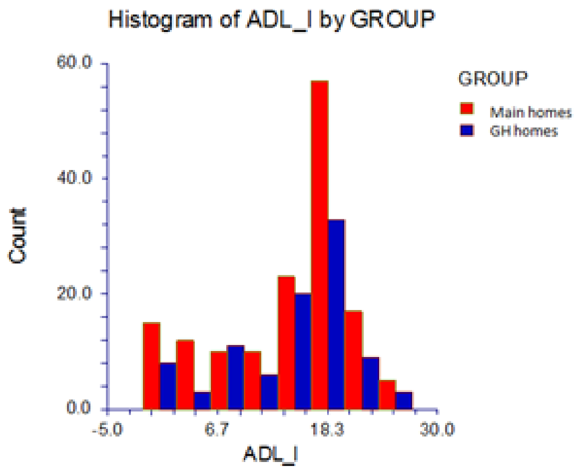
Note. # = the reference group in this study is residents who are the mean age (age = 86.31) male (gender = 0) in Main homes (group = 0); SE = standard error; CI = confidence interval; * p<0.05, ** p<0.01.

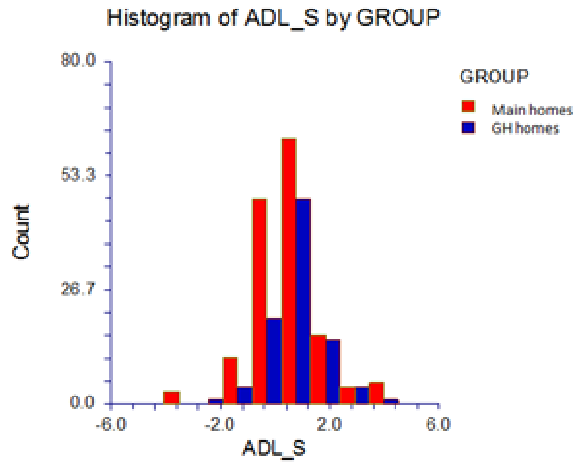
Additional Group Comparisons of Proportional Differences Based on Estimated LGC Models

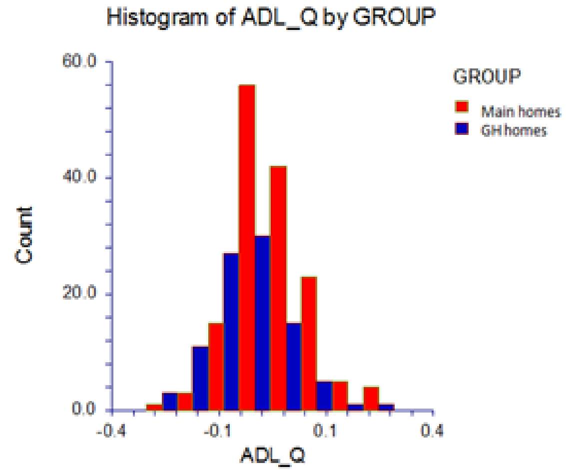
For descriptive purposes, additional analyses to compare proportional difference by groups were conducted with individuals' estimated values of latent variables (i.e., intercept, slope, and quadratic term) obtained from the third step LGC models, controlling for age and gender.

Histograms of Intercepts, Slopes and Quadratic Terms

Figure 4.8 shows the distributions of intercepts, slopes, and quadratic terms by group using histograms. The red and blue bars are the frequencies of intercepts, slopes, and quadratic terms of Main home residents and GH home residents, respectively. Due to the different sample sizes between the two groups (n=149 for Main homes and n=93 for GH home), it is not reasonable to directly compare the frequencies between the two groups for each category of values. However, the overall tendency of distribution can be visually compared. Among these histograms, the slopes of ABS and MSS reveal some different distributions by group. Specifically, the distribution of GH home residents tended to be deviated to the right side than those of Main home residents, which implies that a larger number of residents in GH homes tended to have higher values of slopes (i.e., a more rapid change rate over time) of aggressive behavior symptoms and negative mood symptoms.


Histogram of ADL_I by GROUP
GROUP
Main homes
GH homes
Count
60.0
40.0
20.0
0.0
-5.0
6.7
18.3
30.0
ADL_I


Histogram of ADL_S by GROUP
GROUP
Main homes
GH homes
Count
80.0
53.3
26.7
0.0
-6.0
-2.0
2.0
6.0
ADL_S


Histogram of ADL_Q by GROUP
GROUP
Main homes
GH homes
Count
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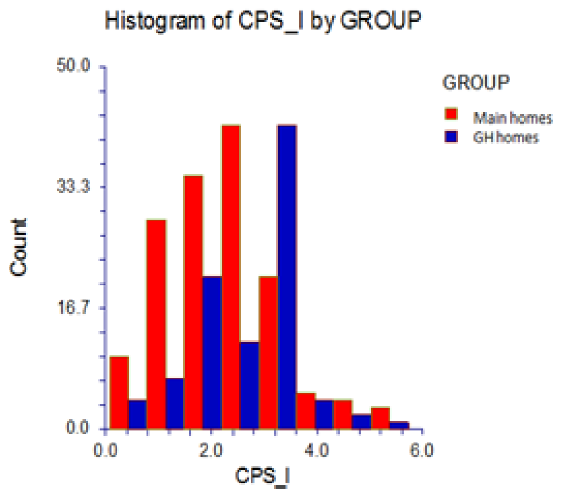
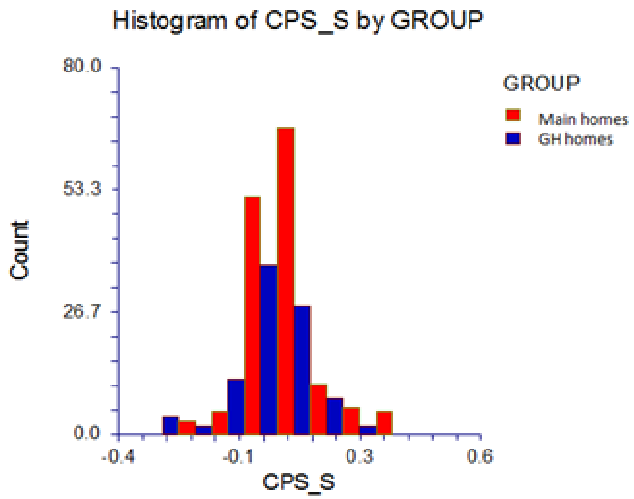
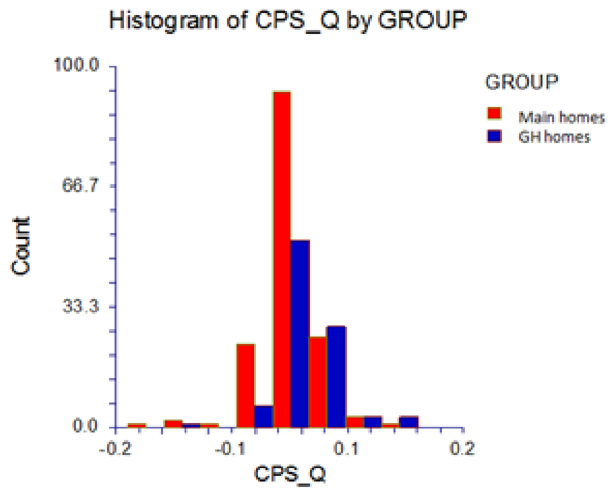
40.0
20.0
0.0
-0.4
-0.1
0.1
0.4
ADL_Q


Histogram of CPS_I by GROUP
GROUP
Main homes
GH homes
Count
50.0
33.3
16.7
0.0
0.0
2.0
4.0
6.0
CPS_I


Histogram of CPS_S by GROUP
GROUP
Main homes
GH homes
Count
80.0
53.3
26.7
0.0
-0.4
-0.1
0.3
0.6
CPS_S


Histogram of CPS_Q by GROUP
GROUP
Main homes
GH homes
Count
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66.7
33.3
0.0
-0.2
-0.1
0.1
0.2
CPS_Q

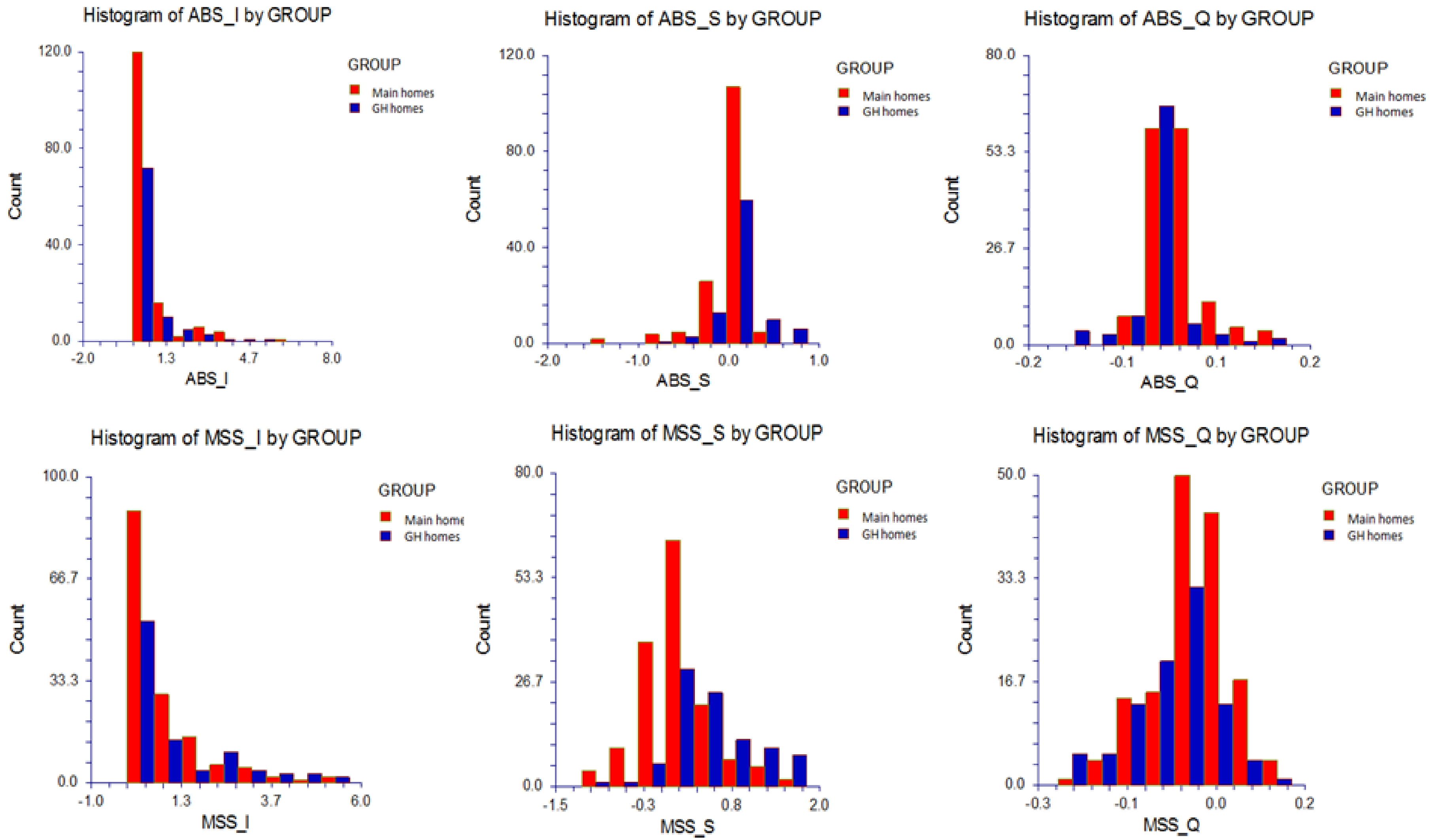


Figure 4.8 Distributions of Individuals' Estimated Intercepts, Slopes and Quadratic Terms of ADL, CPS, ABS and MSS Models

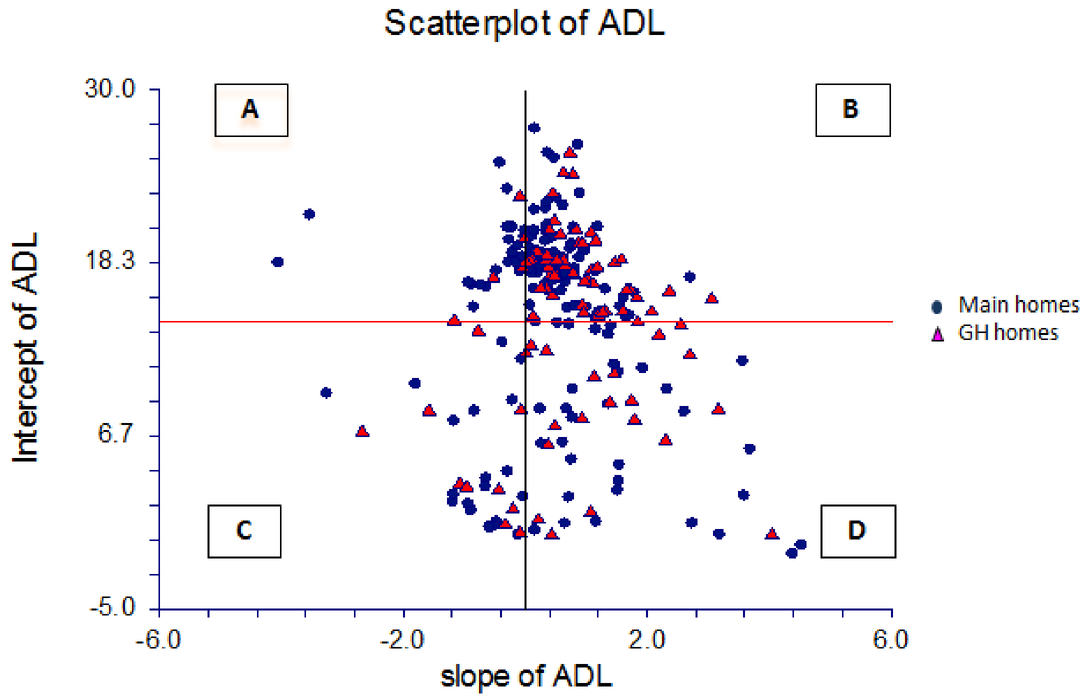
Note. The red and blue bars are the frequencies of estimated value categories of Main home and GH home residents, respectively.

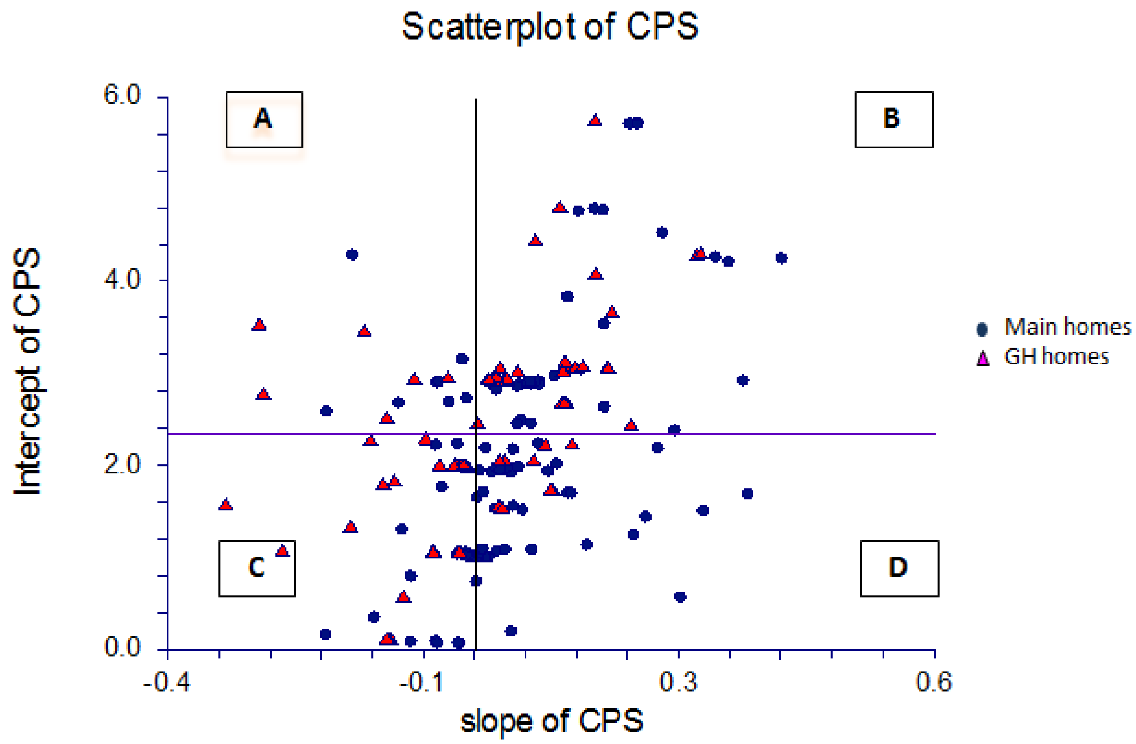
Scatterplots of Intercepts and Slopes

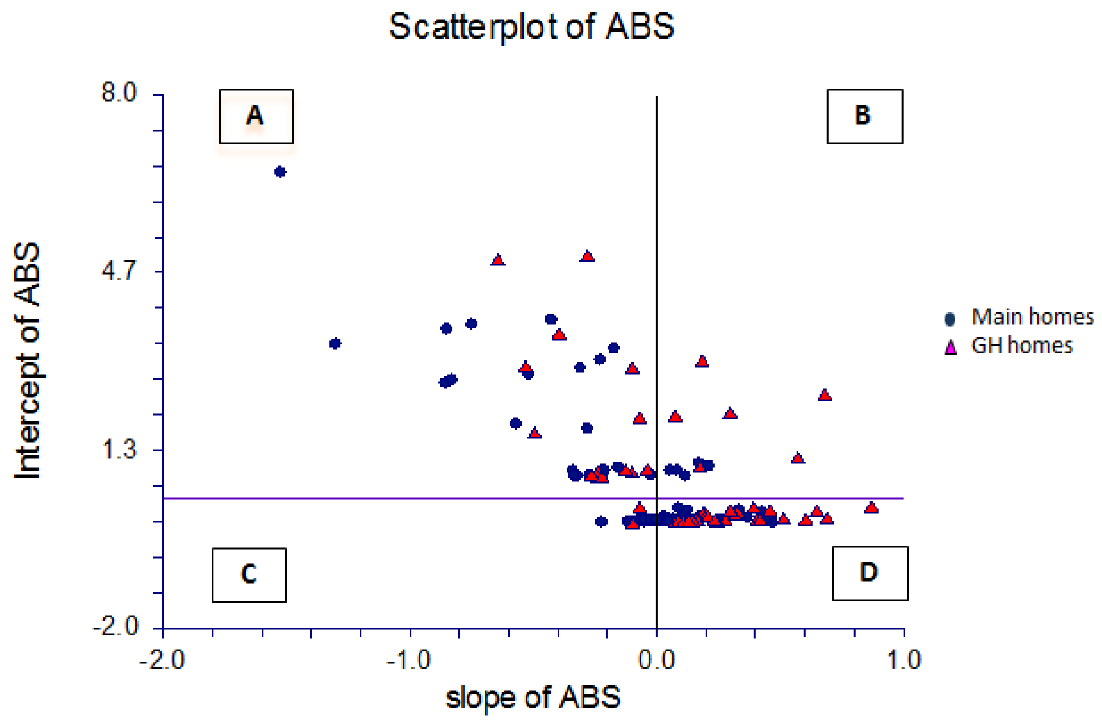
To compare distributions of individuals' change patterns by group in a simpler way, scatterplots were produced with the slope (X-axis) and intercept (Y-axis). Figure 4.9 shows four scatterplots of ADL, CPS, ABS and MSS by group. The mid-lines of the X-axis (slope) are 0, and the mid-lines of the Y-axis (intercept) are the mean values of intercepts for each outcome measure. Based on the signs of the intercept (over the mean or less than the mean) and the slope (over 0 or less than 0), all 242 study participants were categorized into four quadrants. 1) ***Area A*** (intercept > mean and slope ≤ 0) was defined as "*improved group after good initial status*," 2) ***Area B*** (intercept > mean and slope > 0) was defined as "*deteriorated group after good initial status*," 3) ***Area C*** (intercept ≤ mean and slope ≤ 0) was defined as "*improved group after bad initial status*," and 4) ***Area D*** (intercept ≤ mean and slope > 0) was defined as "*deteriorated group after bad initial status*".

Table 4.40 shows the distribution of the four groups of change patterns of the four health outcome measures. Each column shows the proportion of individuals included in that group of area. Additionally, column ***A + C*** is the sum of the proportions of Area A (improved group after good initial status) and Area C (improved group after bad initial status) to additionally define as the "*improved group (regardless of the initial status*)." Among the four health outcomes, Main homes had more than a 30% higher in the proportion of improved group than GH homes regarding ABS and MSS. Specifically the proportions of the improved group of aggressive symptoms (ABS) were 18.3% and 51.7% in GH homes and Main homes, respectively. Particularly Main homes had a significantly higher proportion in Area C (improved after bad initial status of aggressive behaviors). The proportions of the improved group of negative mood symptoms (MSS) were 11.8% and 45.6% in GH homes and Main homes, respectively. In addition, Main homes had a 10.6% higher proportion of the improved group of ADL function. However, in terms of cognitive function (CPS), GH homes had a

13.8% higher proportion of the improved group of cognitive function than Main homes. Particularly, GH homes had higher proportion of Area A (improved group after good initial status) than Main homes, but Main homes had higher proportion of Area B (deteriorated group after good initial status) than GH homes.


Scatterplot of ADL
A
B
C
D
30.0
18.3
6.7
-5.0
-6.0
-2.0
2.0
6.0
slope of ADL
Intercept of ADL
Main homes
GH homes


Scatterplot of CPS
A
B
C
D
6.0
4.0
2.0
0.0
-0.4
-0.1
0.3
0.6
slope of CPS
Intercept of CPS
Main homes
GH homes



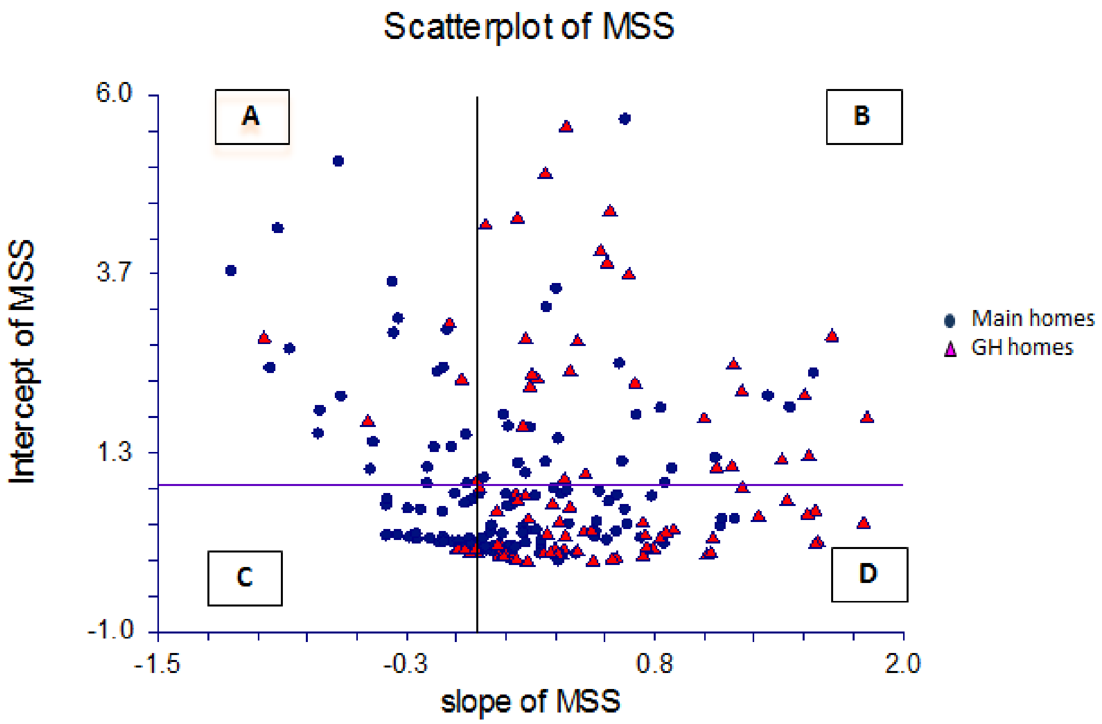


Figure 4.9 Scatterplots of Four Health Outcome Change Patterns by Groups

Note. Midline of X-axis (slope = 0), midline of Y-axis (the mean of intercepts); Area A (intercept > mean and slope ≤ 0); Area B (intercept > mean and slope > 0); Area C (intercept ≤ mean and slope ≤ 0); Area D (intercept ≤ mean and slope > 0).

Table 4.40 Distribution of the Four Types Change Patterns from Scatterplots from Figure 4.9

		Area A	Area B	Area C	Area D	A + C	A+B+C+D
ADL	GH	6.5%	59.1%	11.8%	22.6%	**18.3%**	100.0%
	Main	15.4%	49.0%	13.4%	22.1%	**28.9%**	100.0%
	Difference					***10.6%***	
CPS	GH	6.5%	54.8%	26.9%	11.8%	**33.3%**	100.0%
	Main	5.4%	43.0%	14.1%	37.6%	**19.5%**	100.0%
	Difference					***-13.8%***	
ABS	GH	16.1%	6.5%	2.2%	75.3%	**18.3%**	100.0%
	Main	15.4%	4.0%	36.2%	44.3%	**51.7%**	100.0%
	Difference					***33.4%***	
MSS	GH	5.4%	30.1%	6.5%	58.1%	**11.8%**	100.0%
	Main	14.8%	14.1%	30.9%	40.3%	**45.6%**	100.0%
	Difference					***33.8%***	

Note. Area A (improved group after good initial status: intercept ≤ mean and slope ≤ 0);
Area B (deteriorated group after good initial status: intercept ≤ mean and slope > 0);
Area C (improved group after bad initial status: intercept > mean and slope ≤ 0);
Area D (deteriorated group after bad initial status: intercept > mean and slope > 0);

Correlations of Slopes of the Four Health Outcomes

Although the four LGC models (i.e., ADL, CPS, ABS and MSS) were built separately in this study, these four aspects which represent health-related quality of life might be inter-related. Thus, additional correlations among the slopes of the four models obtained from the final third step were explored for future studies. As Table 4.41 shows, the slope of physical function is positively related to all three slopes of cognitive function (r = 0.134, p-value = 0.037), aggressive behaviors (r = 0.143, p-value = 0.027) and negative mood symptoms (r = 0.138, p-value = 0.031). In addition, the slope of aggressive behaviors are also positively associated with negative mood symptoms (r = 0.272, p-value = 0.000) in whole sample model. These positive correlations between the slopes of the different outcome measures indicates that the residents who had rapid change in one aspect of health were likely to experience more rapid changes in the other aspects of health while residing in nursing homes. However, statistical significances of these correlations were somewhat different depending on the settings, whether the residents were in GH homes or not.

Table 4.41 Correlations of the Slopes of the Four LGC Models

	All sample		GH residents		Main residents	
	Correlation of slopes	p-value	Correlation of slopes	p-value	Correlation of slopes	p-value
ADL & CPS	**0.134***	**0.037**	**0.221***	**0.034**	0.130	0.114
ADL & ABS	**0.143***	**0.027**	0.095	0.365	0.123	0.136
ADL & MSS	**0.138***	**0.031**	**0.271****	**0.009**	-0.004	0.958
CPS & ABS	-0.006	0.920	0.203	0.051	-0.043	0.605
CPS & MSS	0.040	0.538	**0.327****	**0.001**	-0.031	0.712
ABS & MSS	**0.272****	**0.000**	0.175	0.094	**0.185***	**0.024**

Note. * p<0.05, ** p<0.01

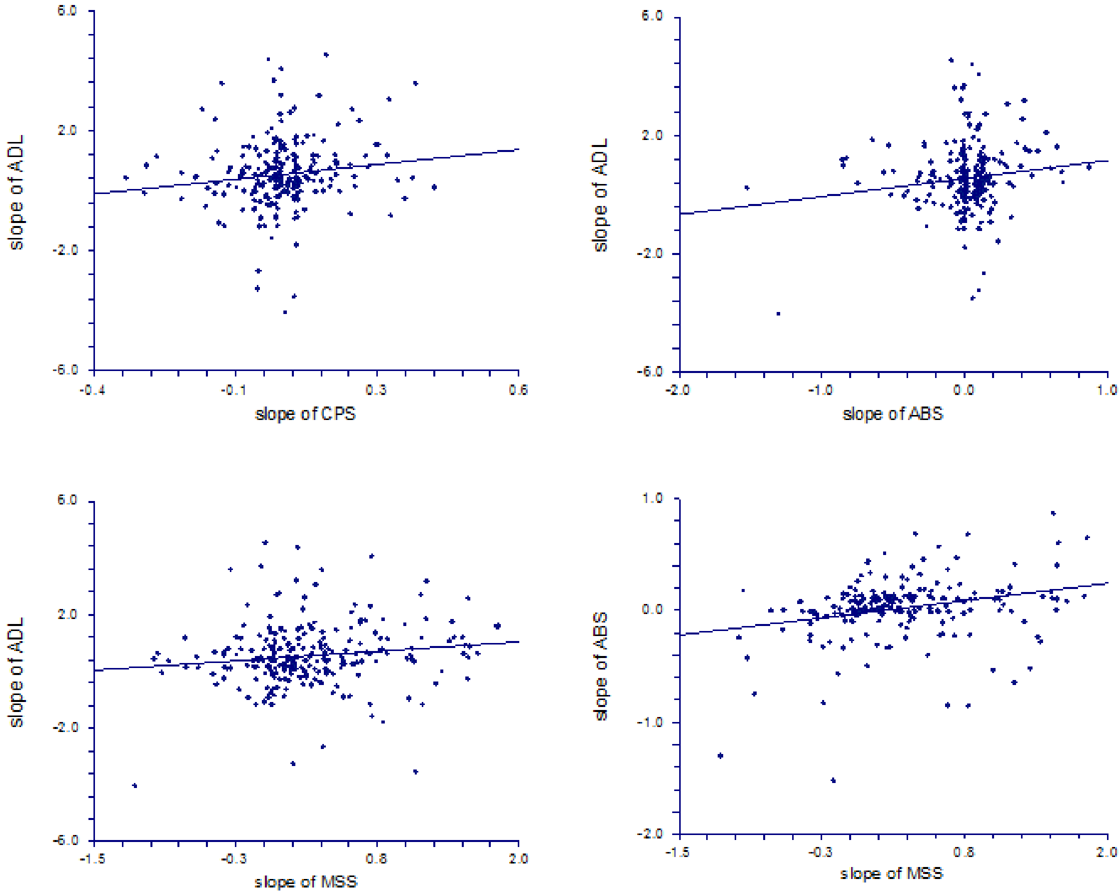


Figure 4.10 Scatterplots with Regression Lines between the Four Significant Correlations

Note. Lines in the scatterplots are regression lines with two slopes.

Summary of Analyses and Results

The purpose of this study was to compare the change pattern of health outcomes (i.e., ADL, cognitive function, aggressive behaviors, and negative mood) between GH home residents and Main home residents controlling for two individual-level covariates (i.e., age and gender). A LGC model was built through three steps to examine each outcome measure, the group effect on three latent variables including intercept (i.e., initial status), slope (i.e., linear rate of change), and quadratic term (i.e., acceleration/deceleration of rate of change) in terms of four health outcome trajectories. The key findings are as follows.

1) The ADL function for nursing home residents became generally worse over time in the whole sample. When the facility type variable was included in the model, the change patterns of the GH home residents was similar to that of Main home residents, which was worsen over time in a linear pattern. After controlling for age and gender, this non-significant group difference on the latent variables was consistent.

2) The cognitive function did not significantly change over time in the whole sample model, which means that the overall change pattern of cognitive function was quite stable over time. In addition, the group effect was not significant for the three latent variables including intercept, slope, and quadratic term despite controlling for four individual-level covariates in the model.

3) The GH home residents were reported to have a higher linear rate of aggressive behaviors with more significant deceleration over time, which is significantly different from the Main home residents with a stable change pattern. These findings of aggressive behaviors were consistent before and after controlling for age and gender in the model.

4) There was a significant group difference in the linear rate of change of negative mood symptoms between the two groups, which means that the negative mood in GH home residents was reported to increase in a linear pattern over time while the Main home residents' mood was quite stable over time. However, after controlling for age and gender, a significant group effect on intercept was identified in addition to a group effect on the slope. This means that GH home residents had a more negative mood than Main home residents at the time of admission, and GH home residents showed a higher rate of change of negative mood scores over time than Main home residents.

CHAPTER 5: DISCUSSION

Discussion of Main Findings

The purpose of this study was to compare the health outcome trajectories between GH nursing home residents and traditional nursing home residents who had stayed in the nursing home at least six months after admission.

Discussion of ADL Function Trajectories

The first main finding was that there was no difference in change patterns of ADL function over time between GH home residents and traditional nursing home residents, although the average ADL functions in both groups reportedly declined over time in a linear pattern. Previous studies still show no consistent findings about whether small-scale nursing home models are better in ADL function outcomes longitudinally depending on the duration of measurements and analysis methods. One study by Kane et al. (2007) examined the effect of GH nursing home model and reported that residents' ADL function at 18 months after admission and was not statistically different from those of two other types of traditional nursing homes controlling for baseline ADL function, but there was less decline in late loss ADLs in GH homes compared to traditional nursing homes (Kane et al., 2007). Another recent study found that 11 physical function measures (e.g., bed mobility, transfer or toilet use) did not show significant changes over time in small-scale nursing homes (described as household models in their study) nor any group difference at 12 months after admission compared to traditional nursing home units, although the eating function improved in the small-scale nursing homes (Chang et al., 2013). However, another mixed method study revealed significant improvement of ADL function in GH home residents compared to traditional nursing home residents for six months in a quantitative analysis, and qualitative interviews showed improvement in health and function of residents after moving to small-scale nursing homes (Molony et al., 2011). However, the quantitative part of their study had several limitations including a small sample size (GH residents = 15 vs. traditional nursing home residents = 10) and only six months of data were included for analysis, making it difficult to generalize the study findings. Considering the quality of the study design, Kane's (2007) study findings may be the most comparable to the findings in current study in terms of sample size (N=140 in Kane (2007) and N=242 in this study) and data collection time (18 months in both studies). Despite a positive finding of ADL function improvement in Molony's (2011) study, it is still difficult to draw any conclusion that small scale nursing homes may lead to improvement in ADL function for nursing home residents based on Kane (2007) and the current study.

The essential elements of the physical environment of small-scale nursing homes include small-scale units and private rooms and bathrooms (Zimmerman & Cohen, 2010). In addition to the staff's care values of encouraging independence for residents, a physical environment that inspires self-care in private areas is generally expected to improve ADL function in small-scale nursing homes (Molony et al., 2011). Furthermore, GH nursing homes philosophically emphasize communal eating in the dining area like a family and self-care in their private rooms and bath-rooms, which may encourage mobility or walking with or without assistance compared to other types of nursing homes. However, while there are positive aspects to private rooms, isolation has been identified as a potential problem in the GH nursing home model because many residents who are not cognitively intact spend more of their time in their rooms (Cutler & Kane, 2009). In addition, the limited involvement in structured activities may lead nursing home residents to not have many opportunities to improve or maintain physical or ADL functions in small-scale nursing homes. However, in order to compare ADL function as an outcome measure, the kinds of care processes that may influence the maintenance or improvement of ADL function of nursing home residents need to be explored together. Sharkey and colleagues (2010) reported that CNAs in GH homes spent significantly more time (141.5 minutes per a resident) providing direct care compared to CNAs in traditional nursing homes (117.6 minutes per resident) (Sharkey et al., 2011). However, it is still unclear whether the nursing rehabilitation/restorative care services were provided differently or how CNAs encouraged self-care for residents differently in their daily care practices to help improve ADL function.

Discussion of Cognitive Function Trajectories

Regarding the cognitive function, there were no differences in change patterns over time between GH home residents and traditional nursing home residents, and the average ADL functions in both groups were stable over time (i.e., not significant average values of slope and quadratic term). Few studies have examined changes in cognitive function of residents to examine the impact of a small-scale nursing home model. Even the two existing studies that included cognitive function as an outcome to examine the impact of small-scale nursing homes utilized different measures of cognitive function, which makes it difficult to compare study findings directly (Chang et al., 2013; Kane et al., 2007). However, overall results of these two previous studies showed consistent to the finding of the current study. Specifically, the current study used the cognitive performance scale (CPS), which was calculated with several cognition related items in MDS. The scoring system of CPS is a continuous variable from 0 to 6, which is effective to estimate a longitudinal model. In another study, short-term memory, long-term memory and recall ability did not reveal any group differences between residents in small-scale homes and traditional nursing homes at a one-year follow-up after admission (Chang et al., 2013). Kane's (2007) study indicated that there was no group difference in the incidence of cognitive impairment within 18 months between GH home residents and traditional nursing home residents as a quality indicator

(Kane et al., 2007). These studies have found that the cognitive function of small-scale nursing home residents did not necessarily improve compared to traditional nursing home residents. Thus, it seems that cognitive function may not be influenced by different care environments and care practices provided by staff in small-scale nursing homes. Further studies need to explore what nursing interventions in terms of cognition are differently provided to residents between different nursing home settings as well as what interventions affect changes of cognitive function. However, 18 months might be not enough to capture a significant change of cognitive function. More studies including a longer period of collected data are warranted.

Discussion of Aggressive Behavior Symptom Trajectories

The LGC models of aggressive behavior symptoms showed that the trajectories between the two groups were quite different over time. While the mean trajectory of aggressive behaviors in the traditional nursing home residents was quite stable over time, an increasing rate of change of aggressive behaviors was reported in the GH home residents. Two previous studies included behavioral symptoms as a measure to examine the impact of a small-scale nursing home model and have reported that there was no group and time differences in behavioral symptoms between small-scale nursing home residents and traditional nursing home residents (Chang et al., 2013; Verbeek et al., 2010). However, interestingly, both studies showed more behavior symptoms in small-scale nursing homes than traditional care units over time despite not at a statistically significant level. Chang et al. (2013) found that the average of behavioral symptoms in small-scale nursing home residents was likely to increase and that of traditional home residents was likely to decrease over 12 months. In addition, the total agitation scores and neuropsychiatric symptoms in a study of Dutch small-scale nursing homes remained the same over time, while those in traditional nursing homes were likely to decrease over 12 months (Verbeek et al., 2010).

Many studies have hypothesized that smaller unit size homes are beneficial for behavioral symptoms because staff know the residents better and build better rapport with residents, although other studies have favored large nursing home sizes, because of the added resources to provide special care and reduced cost (Zimmerman et al., 2010). However, regarding behavioral symptoms for nursing home residents as a care outcome, the findings are not statistically significant (Chang et al., 2013; Verbeek et al., 2010) or negative as in the this study. Nevertheless, the increase in behavioral symptoms including agitation in the small-scale nursing homes model is not necessarily negative finding, since it may suggest that residents had the environmental freedom to reveal such behaviors (Reimer, Slaughter, Donaldson, Currie, & Eliasziw, 2004). In addition, this trend of increasing behavioral symptoms might be influenced by less use of psycho-tropics in small-scale nursing homes. In this regard, the crude means of total medication in a week in both settings were computed by group and time (baseline and six months) using the sample of this study. The average of the total medications in small-scale nursing home residents decreased from 2.92 at baseline to 2.66 at six months after admission, while those of the traditional nursing home residents increased from 3.30 to 3.54. Although means by group and time were not directly compared using statistical methods, it is possible the less use of medication might lead to increasing behavioral symptoms in small-scale nursing homes. To provide more sound evidence of the impact of the small-scale nursing home model on the behavioral symptoms of resident with dementia, replication studies and care process studies are warranted to identify what aspects influence the outcomes.

Discussion of Negative Mood Symptoms Trajectories

In terms of negative mood, GH home residents had higher mood scores than traditional nursing home residents at admission and the rate of change of negative mood scores for GH nursing home residents was reported to be higher than traditional nursing home residents in this study. This is not a consistent finding with previous studies examining mood as an outcome measure, in which positive findings have been reported particularly related to the quality of life. The core intent to develop GH home models as part of culture change in nursing home models was to deinstitutionalize the elderly based on personhood (Zimmerman & Cohen, 2010). Thus, although there were no consistent results related to health outcomes, better or improved quality of life in GH nursing homes is a key area of interest for stakeholders and researchers. Among the four previous studies, one study revealed positive effects of the small-scale nursing home model on mood, as expected. Specifically, GH home residents reported better mood scores compared to residents in traditional nursing homes within 18 months in additional positive findings of quality of life measures (Kane et al., 2007). In contrast, three studies showed that there was no group and time effect in the small-scale nursing home model on the change of negative mood or affects within 6 or 12 months (Chang et al., 2013; Molony et al., 2011; Verbeek et al., 2010). Furthermore, the current study showed that GH home residents were reported to have worse mood scores at baseline and become worse over time compared to traditional nursing home residents.

One important difference between two study groups of findings (i.e., positive effects vs. not significant or negative effects) should be noted here in terms of data sources. While the study that had positive findings on mood utilized the Dementia Quality of Life instrument (Kane et al., 2007), a self-reported scale, two other studies that had no significant group effect were based on data rated by care staff including the MDS rated by RNs (Chang et al., 2013) and QUALIDEM (i.e., a dementia specific quality of life instrument) rated by RNs (Verbeek et al., 2010). The current study, which seems to have negative effects of the small-scale nursing home model on the mood score, was also based on the MDS rated by RNs. Responses to mood or affects, important aspects of quality of life, have a discrepancy depending on who responded, which may be an important threat to be internal validity and reliability of studies. In particular, it becomes a more serious issue for older adults with cognitive impairment, who are the main group of residents in nursing homes (Edelman, Fulton, Kuhn, & Chang, 2005). According to nursing home research about different methods of reporting quality of life (i.e., rated by residents or staff members), staff members are more likely to report a lower quality of life than what residents reported, and responses of residents showed low correlations among several quality of life measures especially among the residents who were more cognitively impaired (Edelman et al., 2005). It is not clear whether residents with severe cognitive impairment are unable to accurately judge their quality of life or if staff are unable to evaluate residents' quality of life due to the residents' communication difficulty. However, self-reporting, particularly on the psychological aspects or quality of life, is not generally recommended when studying nursing home residents who are not cognitively intact (Gerritsen, Steverink, Ooms, de Vet, & Ribbe, 2007). However, the MDS rated by RN staff is not always a good method to capture psychological aspects of nursing home residents. The MDS has been widely used for a number of studies with moderate to good psychometric properties, but there are still concerns about potential bias or errors which increases the threat of inter-rater reliability of MDS ratings completed by RNs using either medical chart review or direct caregiver observations, even though these ratings are based on detailed manuals (Shin & Scherer, 2009). Given the strengths and limitations of measuring methods for mood or affects, all previous studies and this study were based on the only currently reliable method to measure mood regardless of cognitive function of nursing home residents, which makes it difficult to make a generalizable mood outcome among different nursing home models. To capture more accurate and reliable measures of mood or broader concept of quality of life, further studies utilizing different measurement methods depending on the cognitive function are needed.

In addition, regardless of the general issue of inter-rater variations of the MDS data rated by RNs, ascertainment bias is needed to consider interpreting the findings of mood in this study. Assessment of subjective and psychological aspects including pain or mood is strongly related to the each participant's personal characteristics, the assessor's characteristics and assessment practice, called ascertainment bias (Mor et al., 2003). In this study, a small-scale nursing home is a place where around 10 residents and several nursing staff live together, so the relationship with others was reported to be better in GH homes than traditional nursing homes which confirms previous findings (Kane et al., 2007), and residents experienced more home-like feelings in the GH nursing homes (Molony et al., 2011). The close relationship between staff and residents in small-scale nursing homes helps staff be more sensitive to recognize residents' changes in mood and they are more likely to report these changes in the MDS dataset. In addition, from a resident's perspective, residents may be more comfortable expressing their feelings or emotions to the close staff within home-like care environments. This unique close and home-like atmosphere of small-scale nursing homes might lead to a significant increase of recognition and report of negative mood symptoms of residents compared to traditional nursing home residents.

Furthermore, more reports of depressive symptoms are not necessarily negative findings similar to aggressive behavior symptoms in this study, because addressing negative mood symptoms may lead to more active interventions to help residents cope with symptoms. In this regard, the change of anti-depressant use was compared by group from baseline and six months using the same participants in this study. The proportion of those who have used anti-depressants was 53.8% at the baseline assessment, but increased to 61.3% at six months after admission to GH nursing homes. In the traditional nursing homes, the change was much smaller with 57.0% of the residents using anti-depressants at baseline and 58.6% of the residents using anti-depressants at six months. About 8% of the residents increased their use of anti-depressants in GH homes within six months, which may reveal that GH staff is more likely to identify depressive symptoms and provide more active care for depressive symptoms.

It is possible, however, that residents in small-scale nursing homes expressed more negative mood symptoms to the staff than traditional nursing home residents. There is concern that the GH model does not provide sufficient resident stimulation or organized formal group activities (Kane et al., 2007), and the value of emphasizing privacy and individual preferences in a small area may keep residents from having meaningful social relationships. Although the intent of GH homes is to have residents participate in everyday activities such as washing dishes, preparing meals, or doing laundry, which increased interactions with staff and other residents that replaced formalized group activities, in reality, few residents were involved in normative activities (Zimmerman & Cohen, 2010). Those who had higher cognitive function were more likely to participate in self-initiated activities, but those who had less cognitive function were more likely to participate in staff or facility-organized activities (Lemke & Moos, 1989). Given the absence of designated on-site activities staff in GH nursing homes, GH home residents might experience more negative mood symptoms than traditional nursing home residents. Thus, further replication studies with accurate measures of negative moods are needed.

Strengths and Limitations

Strengths

There are several strengths to be noted in this study. First, this is the first study to examine the effect of the GH nursing home model compared to traditional nursing homes using a sophisticated longitudinal analytic model, with latent growth curve modeling. Previous studies employed repeated measurements (usually two or three time points) examining the effects of small-scale nursing homes have largely used traditionally used method such as repeated measured ANOVA (Verbeek et al., 2010), regression models (Kane et al., 2007; Molony et al., 2011) and t-tests (Chang et al., 2013). While these methods result in similar parameter estimates, the LGC model has numerous strengths compared to traditional analytic methods. The LGC model is not restricted to the assumption of sphericity in repeated measured ANOVA, in which the correlation between each time point needs to be the same (compound symmetry). In addition, the LGC model does not list-wise delete for the missing data but uses full information maximum likelihood to incorporate all available data. In addition, the estimates from LGC models are not attenuated since the measurement errors are teased out (Llabre, Spitzer, Siegel, Saab, & Schneiderman, 2004).

Second, this study assessed possible bias due to the missing pattern in the longitudinal data. Longitudinal studies naturally have missing values over time because of dropout at some time points and missing assessments in the middle of all observations. Traditional statistical methods such as regression and repeated measured ANOVA are based on list-wise deletion, so the cases with missing values cannot be included in the analysis, which may lead to a possible sample bias meaning that the sample includes only completers without any missing values. However, this study utilized pattern-mixture modeling, which is strongly recommended for longitudinal data to examine the effects of the missingness pattern over time. There was no significant effect of dropouts or missingness over the stay for residents in the middle of stay in a nursing home on the estimation of latent variables in the models. This allowed the researcher to include all subjects (N=242) in the models without other procedures to control for the missingness pattern.

Third, the quadratic term was included in the LGC models beyond estimating simple linear health patterns. Many longitudinal studies with multiple time points of measurements have been conventionally based on a linear pattern model. However, in the real world, many health outcomes rarely change in a linear pattern. Since this study included seven time points for assessment data, a polynomial model was included for model building. Although polynomial term may not be the best option over other types of non-linear models, this study showed some interesting findings using a quadratic term in the model. Specifically, the aggressive behavior trajectory indicated a significant deceleration of the change rate in a later stage. In addition, the ADL function and mood symptom trajectory graphs also revealed some deceleration of the change rate over time even though they were not at a significant level. This is a significant finding compared to other studies utilized traditional analyzing methods.

Limitations

While this study has strengths that enhance our understanding of the impact of the GH model on the longitudinal changes of residents' health, certain limitations must be acknowledged. First, these data were from four GH organizations. The GH organization usually has one Main building and more than one GH home units. This study included four main buildings (defined as traditional nursing home units) and nine GH home units under four GH organizations. Although Main 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 be the source of contamination of the effects of the GH nursing home model to control groups of traditional nursing homes, which may lead to potential threats to the internal validity of this finding. However, a quasi-experimental study showed that differences of quality of life between the GH and Main units on the same campus were greater than those between the GH units and typical traditional nursing homes from non-GH organizations, in a comparison between only the two groups (Kane et al., 2007). Nevertheless, future studies examining the effects of small-scale nursing homes need to recruit nursing homes outside of the campus for the comparison group of traditional nursing homes.

Second, the selection bias can 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 residents' characteristics might influence different health outcome trajectories including aggressive behaviors and negative mood over time. This is a secondary data analysis study based on a parent study with a retrospective longitudinal design, so it was impossible to control for all potential characteristics in order 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 already been experienced staying in the nursing homes might have different change patterns over time than those who were newly admitted to nursing homes. With access to a larger scale of MDS dataset, several methodological processes to minimize selection bias such as matching of residents' characteristics at baseline and sensitivity analysis would be possible in the future.

Third, many residents were reported to have zero or very low frequency of aggressive behaviors over time, so the means of aggressive behaviors in both nursing home settings were low. Specifically, the distribution of the number of aggressive behaviors showed a Poisson distribution indicating positively skewed distribution and a large portion of zero values. Such a skewed distribution violates the statistical assumptions of usual regression analyses, which can be one of the limitations of this study. Considering the skewed distribution of aggressive behavior symptoms, another analytic approach such as zero-inflated Poisson regression could be utilized for the future studies.

Fourth, the total sample size of residents (N = 242) was not small for building the LGC models in this study, but the number of nursing home units at a higher level is not enough to generalize the study findings (9 GH homes units and 4 Main homes using convenient sampling). Since organizational level variables such as staffing, location, or case-mix may also influence the study findings based on a multi-level data structure in addition to resident-level characteristics, replication studies with a larger number of nursing homes addressing unit-level covariates are necessary in the future.

Fifth, this study was from MDS data rated by RNs working in nursing homes. The MDS has been skillfully developed and widely used for good data sources of research in addition to the purpose of resident classification and care plans, but concerns about data accuracy regarding errors in measures of assessment items has been mentioned in many studies (Arling, Kane, Mueller, Bershadsky, & Degenholtz, 2007; Mor et al., 2003). According to reports of the U.S. General Accounting Office, a poor auditing system on the data accuracy of MDS might worsen the situation of the accuracy problems of MDS (General Accounting Office, 2002a, b). In particular, since psychological aspects of residents including mood and behavioral symptoms may be influenced by the person doing the assessments or the practice culture in nursing homes, potential errors regarding data accuracy can be a limitation of this study.

Implications for Future Research

There are several implications for future research that will enhance the findings of this study. First, in order to improve the quality of health outcome research in this area, more studies are needed to capture an accurate status of residents. Outcome measurements, particularly for the psychological aspects are highly influenced by measurement errors. Particularly residents who are not cognitively intact are more difficult to capture the psychological aspects sensitively. Thus, different measurement strategies regarding psychological aspects depending on the cognitive function of residents are needed for future studies. The new MDS 3.0 version includes new tools to measure residents' mood (PHQ-9), which is a well-established and standardized instrument including interviews and observational versions (Saliba et al., 2012). Primarily the PHQ-9 is based on direct resident interviews, but the staff assesses residents who cannot be interviewed. Since the finding about residents' mood in this study is not consistent with previous studies, further studies with stratification of residents or separate analyses depending on the residents' cognitive function and using MDS 3.0 version (e.g., self-report group and staff observation group) is warranted in order to obtain more accurate data and thus reducing potential measurement errors.

Second, this study separately built four health outcome models because of the sample size was too small to run a multivariate model incorporating simultaneous inter-relationships between multiple health outcomes. As additional analyses regarding correlations of slopes of four health outcomes in the last part of this study indicated, the slope of ADL function was significantly associated with the slopes of cognitive function, behavioral symptoms, and negative mood. In particular, the cognitive function may play the moderating role or as a covariate on the status change of other health outcomes such as ADL function or psychological responses over time rather than the outcome measure. Thus, further studies addressing these correlations in one model are needed to obtain more realistic findings for nursing home residents.

Third, the LGC model has methodological strengths to explore numerous research questions in terms of longitudinal aspects. Since the purpose of this study was to examine the effect of nursing home types (i.e., focusing on relationships among variables), this study is classified into the variable-centered model. On the other hand, the person-centered model is useful to address the heterogeneity or variances in developmental trajectories with longitudinal data and focus on the classification of groups (Muthén & Muthén, 2000). Nursing home residents may have different change patterns over time depending on lots of conditions or intervention effects may influence residents differently. Additional analysis of this study showed there are different distributions different types of trajectories (e.g., improvement group with good initial status, deteriorated group with bad initial status). Thus, future studies using growth mixture modeling (GMM) would be beneficial to explore different trajectories across nursing home residents and compare the distribution of different types of trajectories between small-scale nursing homes and traditional nursing homes in the future.

Fourth, further studies to examine care processes are necessary. To provide practical information to nursing homes to improve residents' health outcomes, concrete strategies of care processes are important. Despite limited data sources, the MDS can be the first place to investigate the significant processes that have varying influences on resident health outcomes in GH nursing homes. However, currently all nursing home care provided to residents cannot be documented in the structured MDS dataset, so a time-and-motion observation study is necessary to examine more comprehensive care processes in terms of types of care and quantity of care. In addition, different work environments including communication, teamwork, and leadership may influence nursing staff`s care-giving processes differently (Temkin-Greener, Zheng, Katz, Zhao, & Mukamel, 2009), so qualitative studies to explore these aspects are needed.

Fifth, a cost-effectiveness study is needed to expand the small-scale nursing home model. Current GH homes are usually located on the same campus with Main homes of the same organization, so independent small-scale nursing homes may not be able to benefit from economies of scale. If costs to run small-scale nursing homes are not sustainable for nursing home providers, this model cannot be a promising nursing home model of care.

Implications for Long-term Care Practice and Policy

As already noted in the discussion about the finding of mood, GH nursing homes provide a limited number of structured activities compared to traditional nursing homes. However, residents' participation in activities dramatically increases if the nursing home staff provides materials or initiates activities. Some residents do not engage in group activities voluntarily; however, the other residents may need the staff's help to promote social engagement in small-scale nursing homes (Zimmerman & Cohen, 2010). Particularly residents who are cognitively impaired need more help from staff to be involved in group activities. Furthermore, residents are likely to engage more when others are participating in activities. Although GH nursing homes do not have on-site activity staff, the CNAs (i.e., Shabhaz) need to develop more diverse strategies to help residents become actively involved in interaction or engagement activities inside and outside of the homes considering residents' cognitive function. For instance, CNAs can help initiate activities for residents who are less cognitively impaired while still respecting their autonomy, and at the same time, organize more group types of activities for residents who are more cognitively impaired.

Despite some mixed findings of health outcomes of the GH home model compared to traditional nursing homes, the fundamental philosophy and direction of nursing home care are definitely innovative and significant. However, one size never fits all. Not everyone may prefer small-scale nursing homes over larger-scale nursing homes, and the small-scale nursing home model may not be cost-effective in rural areas. Thus, policy makers and nursing home care professionals should carefully contemplate what "good quality of care" is in nursing homes and develop diverse models to deliver the optimal nursing home care which balancing cost and quality.

Conclusion

This study examined the effects of the GH nursing home model compared the traditional nursing homes using a sophisticated longitudinal analytic method in order to provide scientific evidence of the small-scale nursing home model. Trajectories of ADL and cognitive function were not different between the two types of nursing home residents.

Trajectories of aggressive behaviors and negative mood became worsen over time in GH home residents compared to traditional nursing home residents. However, the increasing patterns of behavioral symptoms and negative mood in small-scale nursing homes are not necessarily negative findings because it may suggest that small-scale nursing homes provide more environmental freedom to express behavioral symptoms and more proactive care from staff to identify and handle residents' negative mood symptoms. Furthermore, this study was based on MDS data rated by RNs in nursing homes, in which nursing staff might more sensitively recognize residents' changes in behavior and mood so they may be more likely to report them based on the close relationships between staff and residents in small-scale units. To provide more sound evidence of the small-scale nursing home model, future studies should examine residents' longitudinal outcomes using appropriate measures such as applying different measurement methods according to the level of cognition (interviews with residents with good cognitive function and observations for residents with less cognitive function) to reduce measurement bias. In addition, studies are needed to explore the care processes between different types of nursing homes so researchers can provide practical implications and approaches for nursing home providers and stakeholders.

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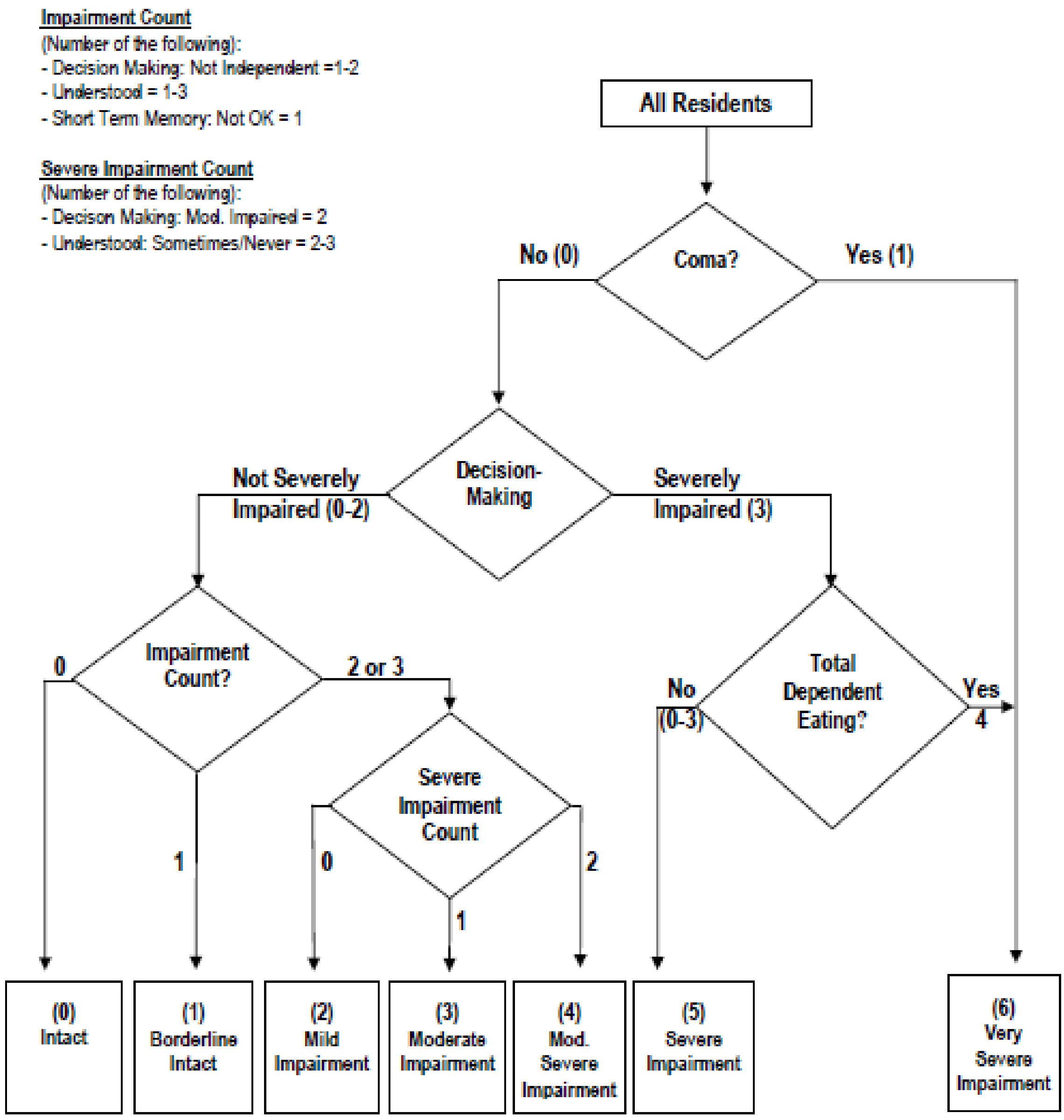
APPENDIX A. **Cognitive Performance Scale (CPS) algorithm**



*Average MMSE for each CPS score in field trial: intact (24.9), borderline intact (21.9). mild impairment (19.2), moderate impairment (15.4), moderate severe impairment (6.9), severe impairment (5.1) (MMSE: 30 is best and 0 is worst)
** Retrieved from interRAI (http://interrai.org/applications/cps_diagram.pdf), and the interRAI indicates that source of this diagram is Morris, J. N., Fries, B. E., Mehr D. R. et al., (1994). MDS Cognitive Scale. *Journal of Gerontology, 49*(3); M174-182.

APPENDIX B. **Mood Scale Score (MSS) Algorithm**

	Condition							
	1	2	3	4	5	6	7	8
MDS item	Verbal expression of distress	Crying, tearfulness	Motor agitation	Leaves food uneaten	Repetitive health complaints	Repetitive verbalizations	Negative statement	Mood symptoms not easily altered
E1a. = 1 or 2								
E1c. = 1 or 2								
E1e. = 1 or 2								
E1f. = 1 or 2								
E1g. = 1 or 2								
E1h. = 1 or 2								
E1m. = 1 or 2								
E1n. = 1 or 2								
E2. = 2								
K4c. = checked								

* Specific MDS items to be used for MSS: **E1a**.Resident made negative statements; **E1c.**Repetitive verbalization; **E1e.**Self deprecation; **E1f.**Expressions of what appear to be unrealistic fears; **E1g.**Recurrent statements that something terrible is about to happen; **E1h.**Repetitive health complaints; **E1m.**Crying, tearfulness; **E1n.**Repetitive physical movement; **E2.**Mood not easily altered; **K4c.** Leaves 25% or more of food uneaten at most meals.

** Retrieved from Health Services Advisory Group (http://nhqi.hsag.com/nhworkgroup_september06/Mood_Scale_Depression.pdf