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Longitudinal Effects of Activities, Social Environment, and Psychotropic Medication Use on Behavioral Symptoms of Individuals With Alzheimer's Disease in Nursing Homes

Ben R. Inventor, PhD, GNP; Carol J. Farran, DNSc, RN, FAAN; Olimpia Paun, PhD, PMHCNS-BC, FGSA; Fawn Cothran, PhD, RN, GCNS-BC; Kumar Rajan, PhD; Sandra S. Swantek, MD; and Judith J. McCann†

ABSTRACT

A secondary data analysis of 25,560 minutes of structured clinical observations from a longitudinal study examined the impact of time-varying background factors, social environment, and psychotropic medication use on behavioral symptoms of nursing home residents with Alzheimer's disease (AD). Data were collected at baseline ($N = 177$), 12 months ($N = 138$), and 24 months ($N = 111$). Mixed-effects regression modeling showed that at 24 months: (a) higher cognitive and physical function and having a private bedroom/bathroom had the most positive influence on resident positive behaviors; (b) use of antipsychotic medications and solitary activities had the most negative influence on resident positive behaviors; (c) higher cognitive function significantly decreased negative behaviors; and (d) care-related activities and total number of psychotropic medications significantly increased negative behaviors. The current study describes risk factors for behavioral disturbances and the impact of activities, social environment, and psychotropic medications on behavioral outcomes in nursing home residents with AD. [*Journal of Psychosocial Nursing and Mental Health Services, 56*(11), 18-26.]

Alzheimer's disease (AD) and other dementias affect 5.7 million Americans and have an annual care cost of approximately $277 billion (Alzheimer's Association, 2018). Over the course of the disease, up to 90% of individuals with dementia may experience behavioral symptoms such as agitation and aggression (Seitz, Purandare, & Conn, 2010; Wang, Borisovskaya, Maxwell, & Pascualy, 2014) that hasten their placement in nursing homes (Miller, Schneider, & Rosenheck, 2011; Yaffe et al., 2002). In nursing homes, behavioral symptoms increase the direct cost of care and may challenge even experienced professional caregivers (Ayalon, Arean, Bornfeld,

& Beard, 2009; Ellis, Molinari, Dobbs, Smith, & Hyer, 2015; Murman et al., 2002). Poorly managed behavioral symptoms have alarming consequences in the nursing home environment, including premature hospitalization, injuries, use of restraints, inappropriate psychotropic medication use, more rapid cognitive and functional decline, and overall reduced resident quality of life (Ballard, Corbett, Chitramohan, & Aarsland, 2009; Kunik et al., 2010; Okura et al., 2011). Therefore, it is essential that nursing home staff explore evidence-based strategies to effectively manage symptoms and prevent negative consequences of poor behavioral management.

Behavioral symptoms are complex phenomena. In the Need-Driven Dementia-Compromised Behavior (NDB) model, Algase et al. (1996) conceptualized behavioral symptoms as indications of unmet needs. According to the model, behavioral symptoms occur when an individual pursues a goal or expresses a need that reflects the interaction between that individual's background and precipitating proximal factors. Background factors, such as cognitive and physical function, are properties of the individual with dementia. Proximal factors, such as physical and social environment, are properties of the individual's immediate environment and may precipitate behaviors in individuals with changing needs. Unmet and/or misunderstood needs often result in ineffective management of behavioral symptoms (Algase et al., 1996).

Pharmacological and nonpharmacological strategies are commonly used to manage behavioral symptoms of nursing home residents. Pharmacological strategies, such as use of antipsychotic agents, have not demonstrated strong efficacy and pose serious adverse effects, including sedation, Parkinsonism, altered mental status, and death (Ballard et al., 2009; Maust et al., 2015; Rhodes-Kropf, Cheng, Castillo, & Fulton, 2011). Conversely, nonpharmacological strategies, such as resident activities and social and environmental modifications, have no serious adverse effects and are recommended as first-line treatment for behavioral symptoms (American Geriatrics Society & American Association for Geriatric Psychiatry, 2003; Centers for Medicare & Medicaid Services [CMS], 2017; Lyketsos et al., 2006). These nonpharmacological strategies have been effective in reducing nursing home resident behaviors such as boredom, sensory deprivation, and feelings of loneliness (Ballard et al., 2009; Cohen-Mansfield, Thein, Marx, Dakheel-Ali, & Freedman, 2012; Conn & Seitz, 2010; Kolanowski, Litaker, Buettner, Moeller, & Costa, 2011; Low et al., 2014). However, efficacy of nonpharmacological strategies was found to be affected by their time-limited dosing and cost of delivery (Conn & Seitz, 2010; Jutkowitz et al., 2016; O'Connor, Ames, Gardner, & King, 2009a,b). Few studies have examined the longitudinal effect of nonpharmacological strategies on behavioral outcomes. Given the trajectory of the disease process, behavioral outcomes in response to nonpharmacological strategies likely differ as cognitive and physical function decline.

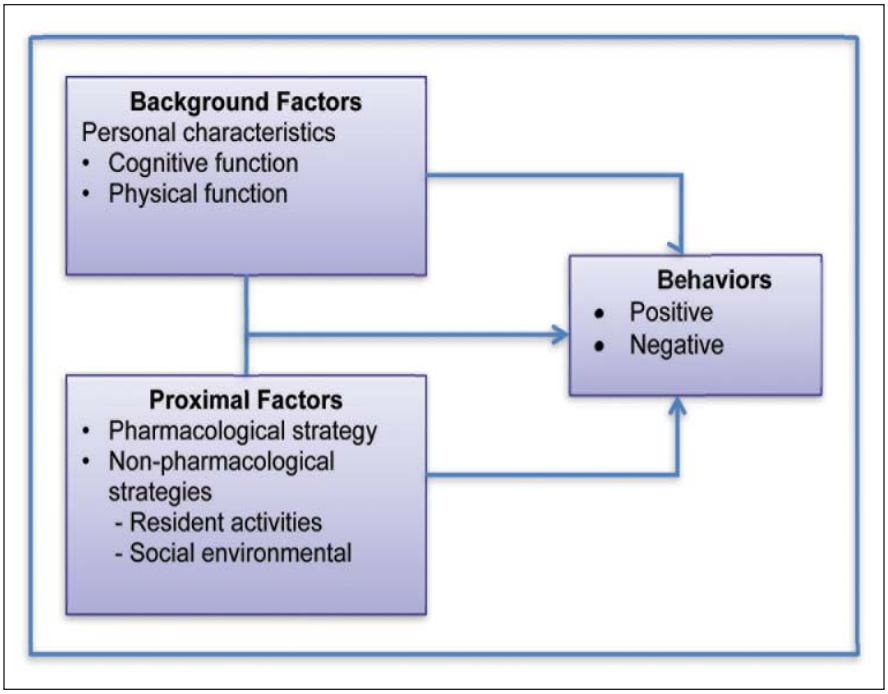

Figure. Need-Driven Dementia-Compromised Behavior model. Adapted from Algase et al. (1996).

The purpose of the current study was to examine the longitudinal impact of time-varying background factors (e.g., cognitive and physical function), and proximal factors (e.g., resident activities, social environment, psychotropic medication use) on behavioral symptoms of nursing home residents with AD. Specific aims were to: (a) examine differences between two facilities in resident background factors, proximal factors, and behavioral symptoms at baseline, 12 months, and 24 months; (b) controlling for age, gender, and site, examine which background and proximal factors have the most significant influence on positive behaviors; and (c) controlling for age, gender, and site, examine which background and proximal factors have the most significant influence on negative behaviors. The NDB model was adapted to guide this inquiry of selected background and proximal factors (Algase et al., 1996) (**Figure**). The parent institution Institutional Review Board approved the current study.

METHOD

Data Sources and Procedure

The current secondary data analysis examined existing clinical and observational data from a 2-year longitudinal study of temporal patterns of behaviors in nursing home residents with AD in two different facilities (McCann, Gilley, Bienias, Beckett, & Evans, 2004; McCann, Gilley, Hebert, Beckett, & Evans, 1997).

Trained observers completed 60 5-minute direct observations of each resident over 12 consecutive weekdays between the hours of 9 a.m. and 9 p.m. A structured time-sampling technique ensured equal distribution of sampling times for all residents. Data were collected at three separate timepoints: baseline (N = 177), 12 months (N = 138, 77.9%), and 24 months (N = 111, 62.7%). All attrition was due to death. A total of 25,560 minutes of observational sessions were collected and analyzed for all participants.

Observers used a paper-and-pencil behavioral observation instrument documenting seven categories indicating residents' behaviors and the context of behaviors. Defined target behaviors included specific discreet behaviors that could be reliably observed. Categories for behaviors included level of alertness, facial affect, and behavioral symptoms. Categories for the behavioral context included activity in which the resident was engaged, resident's location, types of individuals with resident (e.g., staff, family, friends), and their proximity to the resident. For each observational session, a participant was observed for 5 consecutive minutes. Each minute was treated as a discreet interval for an occurrence of behavior. A behavioral score for an observational session ranged between 0 (*behavior did not occur in the 5-minute interval*) to 5 (*behavior occurred ≥5 times in the 5-minute interval*). Researchers assessed interrater reliability of observations every 3 months, with retraining provided as necessary, to maintain kappa coefficients ≥0.90 (McCann et al., 1997).

Participants

The parent study recruited participants from two nursing homes in a large Midwestern metropolitan area. Facility 1 was a 256-bed facility with three 30-bed special dementia care units (SDCUs). Facility 2 was a 235-bed facility with five traditional non-dementia care units (TNDUs) that included residents with dementia throughout each of the five units. Facilities were comparable in terms of residents' social and economic status and race and ethnic backgrounds; nonprofit status, degree of community, and religious sponsorship; and age of facility buildings (McCann et al., 2004). Eligible residents diagnosed with AD were located in one of the three SDCUs or five TNDUs on study initiation or were admitted to study units during the 18-month enrollment period. Inclusion criteria were: (a) diagnosis of moderate to severe AD based on the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association diagnostic criteria (McKhann et al., 1984); (b) a Mini-Mental State Examination (MMSE) score ≤18 (Folstein, Folstein, & McHugh, 1975); (c) 65 years or older; and (d) able to perform at least two tests of lower extremity physical function or activities of daily living (Kuriansky & Gurland, 1976). Individuals with mild cognitive impairment or those enrolled in a hospice program were excluded. Of the 371 eligible residents, 10 (2.7%) declined evaluation and 185 met inclusion criteria. A letter describing the study was sent to the primary contact identified by the nursing home for assent, and 177 nursing home residents provided signed consents.

Given the trajectory of the disease process, behavioral outcomes in response to nonpharmacological strategies likely differ as cognitive and physical function decline.

Measures

Background Factors. The current study examined three resident background factors: demographics, cognitive function, and physical function. Demographics included age, gender, and race. Cognitive function was measured using the 30-item MMSE (range = 0 to 30) (Folstein et al., 1975). Physical function was measured using a composite score of residents' performance of activities of daily living (PADL) in six domains (range = 0 to 54): eating, drinking, grooming, dressing upper and lower body, and fine motor coordination (e.g., buttoning/unbuttoning shirt) (Kuriansky & Gurland, 1976). Data for background factors were collected at baseline, 12 months, and 24 months.

Proximal Factors. Researchers examined two major proximal factors: pharmacological and nonpharmacological (i.e., resident activities, social environment) strategies. Pharmacological strategies included scheduled daily psychotropic medication use of any of four classes of medications collected from residents' medical records (range = 0 to 4): antipsychotic, antidepressant, anti-anxiety, and hypnotic agents.

Nonpharmacological strategies included resident activities and social environment. Resident activities were categorized into seven groups: solitary, care-related, family/friend visits, structured (planned facility program), unstructured (unplanned facility program), large (activities with six or more individuals), and small (activities with two to five individuals). Social

environment included three categories: location of behavior occurrence (i.e., off unit—observed, dining room, common area, corridor, own bedroom, other's bedroom, activity room, shower/tub/bathroom); social proximity (i.e., individuals in area >10 feet, 3 to 10 feet, <3 feet); and type of individuals present (i.e., staff, family, residents, others). Observers collected data for nonpharmacological strategies at each observation session.

Outcome Variables

Researchers examined two primary outcome variables: positive behaviors and negative behaviors. Specific behaviors categorized as positive or functional included: (a) smiling—positive facial affect; (b) positive physical expressions, including compliance/cooperation with care, participation in group activities, and acceptance of need for assistance; and (c) talking or listening—engaging in conversation. Specific behaviors categorized as negative or disruptive included: (a) grimacing—negative facial affect; (b) verbal aggression (e.g., screaming, cursing); (c) physical aggression (e.g., physical intrusion, destroying property); (d) physical nonaggression (e.g., noncompliance/noncooperation with care-related activity); and (e) repetitive behaviors. Except for negative facial affect, negative or disruptive behaviors were formerly described as agitation (Cohen-Mansfield, 1986).

Statistical Analyses

Descriptive statistics were reviewed for each variable at baseline, 12 months, and 24 months. Differences in cognitive function, physical function, psychotropic medication use, activity, social environment, and behavioral symptoms between residents with AD in SDCUs and TNDUs at all time points were examined using *t* tests, chi-squared tests, or Wilcoxon rank sums, as appropriate. To describe and compare variables between settings, researchers first computed the proportion of observed minutes in which the event occurred across all records (total events/observed minutes), and used the mean values of this proportion for description and comparison.

Researchers computed composite scores for positive and negative behaviors by 5-minute intervals as primary outcomes of analysis. Composite scores represented the number of minutes in each 5-minute interval that a positive or negative behavior occurred. Because most target behaviors had a low rate of occurrence, researchers converted the base values of these behaviors to 10 units. Rate ratios for regression analysis reflect a 10-percentage point increase or decrease of risks.

To determine which background and proximal factors had the most influence on positive and negative behavioral symptoms over time, researchers used a mixed regression model with fixed and random effects. This model uses all available data from each participant and can handle time-varying covariates and irregularly spaced measurement occasions (Gibbons, Hedeker, & DuToit, 2010). Positive and negative behaviors were modeled over time. All background and proximal factors were entered as time-varying covariates in the model. Researchers controlled for age and gender because there were significant differences in these two variables between settings. Researchers also controlled for site (SDCUs) and tested each variable for site interaction because of a possible interaction effect of SDCUs on overall behavior outcomes (Rovner, Steele, Shmuely, & Folstein, 1996). SAS 9.4 was used for all statistical analyses.

RESULTS

Aim #1: Resident Background Factors, Proximal Factors, and Behavioral Symptoms

Comparison of resident characteristics, activities, social environment, psychotropic medication use, and behavioral symptoms for two facilities at three time points is presented in **Table 1** and **Tables A** and **B** (available in the online version of this article). For background factors, SDCU residents remained more cognitively impaired than TNDU residents. However, difference in physical function was not significant between settings over time. With regard to proximal factors, there were significant differences related to activities and social environmental factors, but not psychotropic medication use. SDCU residents remained significantly engaged in more structured activities and large groups, whereas TNDU residents participated in more solitary activities. For social environmental factors, SDCU residents continued spending more time in the activity room, other residents' bedrooms, and in the presence of residents and other individuals, whereas TNDU residents remained more isolated at all time points. In terms of behavioral symptoms, there were no significant differences in total positive and negative behaviors. However, a difference in specific behaviors was evident. SDCU residents had more aggressive behaviors compared to TNDU residents across all time periods.

The impact of time-varying background factors (i.e., cognitive function, physical function) and proximal factors (i.e., resident activities, location, social proximity, individuals present, psychotropic medication use) on positive and negative behaviors was examined at 24 months and is presented in **Table 2**.

Aim #2: Predictors of Positive Behaviors

Controlling for age, gender, and site, residents with better cognitive and physical function exhibited significantly more positive behaviors. Moreover, being located in their own bedrooms with a personal shower/bathroom and spending time with other individuals were positively associated with positive behaviors. Conversely, solitary activities and use of more antipsychotic medications were associated with significantly fewer episodes of positive behaviors.

Aim #3: Predictors of Negative Behaviors

Controlling for age, gender, and site, residents with lower cognitive function had significantly more episodes of negative behaviors. Increased care-related

activities and use of more psychotropic medications were significantly associated with more episodes of negative behaviors.

DISCUSSION

To the researchers' knowledge, the current study is the first to examine the longitudinal effects of time-varying background factors (cognitive function, physical function) and proximal factors (resident activities, social environment, psychotropic medication use) on positive and negative behavioral symptoms of nursing home residents with AD.

Researchers found the effects of cognitive and physical function on behavioral symptoms were somewhat predictable over time, as conceptualized in the NDB model (Algase et al., 1996). Residents with higher cognitive and physical function had more episodes of positive behaviors, a relationship supported in the literature (Zuidema, Koopmans, & Verhey, 2007). Physical function had time-varying effects on positive behaviors, but not on negative behaviors. Ability to perform activities of daily living decreases dependence on others, and supports one's autonomy and personhood, resulting in more positive behaviors (Kitwood, 1997).

Several proximal factors had a significant impact on positive and negative behaviors. Being located in one's own bedroom with a private shower/bathroom and spending time with other individuals were significantly associated with positive behaviors over time. These findings suggest lowered stress (familiarity with surroundings—one's own bedroom) and decreased need-based behaviors (physiological need—shower/bathroom, psychosocial need—being with others) (Algase et al., 1996; Hall & Buckwalter, 1987). However, there was an interaction between site and private bedroom. This interaction could be due to SDCU residents spending significantly less time in their own bedrooms than TNDU residents. The current analysis also showed that solitary activities decreased the likelihood of positive behaviors. This finding sug-

TABLE 1

RESIDENT CHARACTERISTICS IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

	Baseline			12 Months			24 Months		
Characteristic	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Age (years)	82.8 (5.6)	87.2 (5.8)	<0.0001	83.4 (6.0)	88.3 (5.7)	<0.0001	83.8 (5.7)	88.6 (5.5)	<0.0001
Male (%)	27.6	14.4	<0.05	23.9	12.7	0.09	15.7	13.3	0.73
Married (%)	31.0	6.7	0.0004	29.9	8.5	0.008	27.5	10.0	0.06
Functional level									
MMSE score[a]	6.8 (5.8)	10.9 (5.3)	<0.0001	5.5 (5.7)	9.2 (6.1)	0.0002	4.2 (4.0)	6.7 (5.9)	0.03
PADL score[b]	41.8 (13.6)	46.6 (11.0)	<0.0001	35.5 (16.9)	42.4 (14.8)	0.01	33.4 (17.6)	37.6 (18.4)	0.09

Note. SDCU = special dementia care unit; TNDU = traditional non-dementia unit; MMSE = Mini-Mental State Examination; PADL = performance of activities of daily living. Values represented as mean (SD) unless otherwise noted.

[a] *Score range = 0 to 30, with higher scores indicating better cognitive function.*

[b] *Score range = 0 to 54, with higher scores indicating better performance of activities of daily living.*

TABLE 2

FINAL REGRESSION MODELS FOR POSITIVE AND NEGATIVE BEHAVIORS AMONG NURSING HOME RESIDENTS AT 24 MONTHS (*N* = 426), CONTROLLING FOR AGE, GENDER, AND SITE

Variable	Estimate (SE)	*p* Value
Positive behaviors		
Intercept	31.06 (7.52)	<0.0001
Age	–0.01 (0.004)	0.008
Male	–0.05 (0.05)	0.30
Site (SDCU)	0.10 (0.07)	0.14
MMSE score	0.01 (0.004)	0.003
PADL score	0.01 (0.002)	<0.0001
Antipsychotic medications	–0.24 (0.06)	<0.0001
Antipsychotic medications–SDCU interaction	0.29 (0.08)	0.0002
Solitary	–0.13 (0.02)	<0.0001
Bedroom (own)	0.05 (0.02)	0.003
Bedroom (own)–SDCU interaction	–0.04 (0.01)	0.003
Shower/bathroom	0.13 (0.06)	0.03
Individuals in area >10 feet	–2.71 (0.75)	0.0004
Individuals in area 3 to 10 feet	–2.73 (0.75)	0.0003
Individuals in area <3 feet	–2.68 (0.75)	0.0004
Others	0.07 (0.03)	0.02
Negative behaviors		
Intercept	3.24 (0.14)	<0.0001
Age	–0.005 (0.009)	0.59
Male	–0.15 (0.14)	0.28
Site (SDCU)	–0.03 (0.12)	0.82
MMSE score	–0.05 (0.008)	0.0001
Total psychotropic medications	0.16 (0.06)	0.01
Care-related activities	0.40 (0.11)	0.0002

Note. SE = standard error; SDCU = special dementia care unit; MMSE = Mini-Mental State Examination; PADL = performance of activities of daily living.

gests that providing residents with appropriate activities may promote positive behaviors (Cohen-Mansfield et al., 2012; Kolanowski et al., 2011).

Researchers also found that all three social proximity variables (individuals in area >10 feet, 3 to 10 feet, <3 feet) had a significant negative impact on positive behavior. This negative effect may be due to crowding and lowered stress threshold in residents with AD. Crowding could happen in high traffic areas with significant movement and noise, such as the dining room, activity room, and common area (Algase, Antonakos, Beattie, Beel-Bates, & Song, 2011). With disease progression, the stress threshold level of residents with AD declines (Hall & Buckwalter, 1987). Because of this declining stress threshold level, environmental stress (i.e., overstimulating environment, crowding) could decrease the occurrence of positive behaviors (Lawton, 1985).

Researchers found two significant proximal factors for negative behaviors: care-related activities and psychotropic medication use. Residents were more likely to exhibit negative behaviors when assisted with personal care. This finding is supported by previous studies of care-related behavioral symptoms in nursing homes (Beck et al., 1998; Schreiner, 2001). Psychotropic medication use independently contributed to behavioral outcomes. The current study found that antipsychotic medications significantly decreased

positive behaviors, and increased number of total psychotropic medications resulted in higher occurrences of negative behaviors. These findings provide evidence that long-term use of psychotropic medications, especially antipsychotic agents, might not be effective in managing behavioral symptoms in individuals with dementia (Ballard et al., 2011). Furthermore, the current findings strengthened the evidence against long-term use of psychotropic medications for behavioral management. Results show that psychotropic medications had opposite outcomes of what was expected over time. There was site interaction, however, with use of antipsychotic medications, potentially due to increased use of these medications in SDCUs.

Interestingly, group activities did not have a significant impact on behavioral outcomes at 24 months. Disease progression tends to affect negative emotions more than positive emotions, which may explain why large and small groups no longer influence negative behaviors over time (Beck et al., 2002; Kolanowski et al., 2011). However, the nonsignificant impact of group activities in positive behaviors warrants further exploration. Individualized activities based on one's interests and cognitive and physical abilities, rather than group activities, could promote positive behaviors in individuals with severe cognitive deficits (Cohen-Mansfield et al., 2012; Kolanowski et al., 2011). In terms of setting, researchers did not find a significant association between SDCUs and positive and negative behavioral outcomes at 24 months. Research has shown varying effects of SDCUs on behavioral symptoms (Grant & Ory, 2000). Findings suggest that future research should not focus on the effect of SDCUs as a site designation, but instead examine which programmatic features have significant effects on behavioral symptoms and other resident outcomes, such as quality of life.

STRENGTHS AND LIMITATIONS

The current study had several strengths. Researchers used existing data collected with objective and reliable measures of behavior, and systematic time-sampling methods. The study had a large sample of residents from multiple units of two different nursing homes and included all residents who met criteria for AD. Importantly, the study was not limited to individuals with behavioral symptoms. Participation (97.3%) was excellent, decreasing potential bias by differential participation. In addition, 24-month follow up allowed for assessment of residents through a period of time encompassing significant disease progression. A large number of behavioral observations were systematically acquired on each participant, so researchers were able to capture meaningful changes in behavioral outcomes over time.

The study had several limitations. First, data in the parent study were collected between 1990 and 1992, so history should be considered when interpreting results. After that time period, dementia care experienced increased efforts to improve quality of care in nursing homes, including a decrease in use of antipsychotic agents and implementation of person-centered dementia care (American Geriatrics Society & American Association for Geriatric Psychiatry, 2003; Ballard et al., 2009; CMS, 2017; Lyketsos et al., 2006; Maust et al., 2015; Rhodes-Kropf et al., 2011). Despite these efforts, nursing home culture, staffing standards, quality of care, and quality of life for many nursing home residents have not changed considerably (Doty, Koren, & Sturla, 2008; Harrington, Schnelle, McGregor, & Simmons, 2016; Shier, Khodyakov, Cohen, Zimmerman, & Saliba, 2014), thus rendering findings of the current study relevant more than 2 decades post-parent study. Second, data collection in the parent study was limited to weekdays between 9 a.m. and 9 p.m. Care-associated behaviors occurring in early morning or late night and behaviors due to sleep disturbances, change in routine, weekend staff patterns, and weekend visitors were not observed. However, it should be noted that the hours between 9 a.m. and 9 p.m. include a significant portion of time during which behavioral disturbances are typically seen (McCann et al., 2004). Third, only residents with moderate to severe AD were included, so findings may not extend to those with mild cognitive impairment or with dementia other than AD. Fourth, the MMSE tool (Folstein et al., 1975) has held a proprietary status through Psychological Assessment Resources after 2001 (Martin & O'Neil, 2009). Although authors of the parent study were in compliance with the copyright at that time, future research studies should consider using other reliable and valid non-proprietary measures for cognitive function to avoid potential legal matters. Fifth, the study population included mostly White female residents of two nursing homes, and may not be representative of other SDCUs or TNDUs. Results may not be generalized to all nursing home settings.

CONCLUSION AND RECOMMENDATIONS

Providing for unmet needs of nursing home residents with AD decreases behavioral symptoms. The current study demonstrates the time-varying influence of different background and proximal factors that increase positive and decrease negative behaviors. The study highlights the somewhat stable influence of cognitive and physical function on behavioral symptoms over time. Nursing home staff should consider both factors when choosing behavioral interventions to elicit more desirable resident outcomes. Engaging residents in individualized activities that they can successfully perform could promote positive behaviors.

The current study also presents evidence that long-term use of psychotropic medications, especially antipsychotic agents, as a behavior-changing strategy might be associated with decreased, rather than increased, positive behaviors. This finding is particularly

relevant to prescribing clinicians, including psychiatric nurse practitioners. Alternatively, psychiatric nurses can train nursing home staff to improve social environmental components (e.g., avenues for socialization, quality of individuals present, ambience of location) to foster positive behaviors and potentially decrease use of psychotropic medications.

Finally, the current study shows that improving approaches to care-related activities may reduce episodes of negative behaviors. Nursing home staff can use person-centered approaches during care-related activities (e.g., toileting, personal hygiene, grooming) to support residents' personhood and encourage successful engagement in these activities (Kitwood, 1997). These findings have significant implications for the care of nursing home residents with AD.

The current study suggests several areas requiring further research. The NDB model (Algase et al., 1996) was appropriate to use for managing need-driven behavioral symptoms. However, the major focus of this model has been on symptom management. Less attention has been given to individuals with dementia, whose care needs vary along a continuum due to the progressive nature of the disease process, and especially to individuals with dementia in long-term care settings. Therefore, there is a need to examine and/or develop other theoretical perspectives that place greater emphasis on maintaining personhood, and address issues of quality of care and quality of life (Murray & Boyd, 2009). In addition, secondary analysis of existing data was limited to selected background and proximal factors of the NDB model (Algase et al., 1996). Considering implications of study findings, the potential to test the full model in future research should be considered.

Further research is needed to test well-controlled interventions that maintain current function of activities of daily living in an effort to promote positive behaviors. Further studies are also needed to examine the temporal associations between psychotropic medications and behaviors as well as to find effective, safe, and appropriate use of psychotropic medications, and reduce use of these medications where feasible. Future studies should examine mechanisms for improving social environment, such as enhancing the ambience of the environment and exploring the role of non-nursing home staff in implementing nonpharmacological interventions (e.g., volunteers providing humor therapy, pet therapy, arts and crafts, song and dance). Studies that identify methods for improving specific care-related activities (e.g., toileting, dressing, oral care) should also be conducted. Future studies should include more men and participants of different races to increase generalizability of results.

Study results increased researchers' understanding of the time-varying effects of cognitive and physical function, activities, social environment, and psychotropic medication use on behavioral outcomes of nursing home residents with AD. This knowledge may guide research toward better and effective interventions that improve not only behavioral symptoms, but also quality of life for nursing home residents with dementia.

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Dr. Inventor is Assistant Professor, Dr. Farran is Professor Emeritus, Dr. Paun is Associate Professor, and Dr. Cothran is Assistant Professor, College of Nursing; Dr. Swantek is Associate Professor, Department of Psychiatry, Rush University Medical Center, Rush University, Chicago, Illinois; and Dr. Rajan is Professor, School of Medicine, University of California, Davis, California.

†Deceased.

The authors have disclosed no potential conflicts of interest, financial or otherwise. This research was supported in part by the National Institute on Aging and National Institutes of Health grants U01 AG10315 and AG09966. This research was also supported by a pre-doctoral grant to Dr. Inventor from the National Hartford Centers of Gerontological Nursing Excellence. The authors thank George Dombrowski and his staff for data management, and Todd Beck for his assistance with analytic programming and analysis.

Address correspondence to Ben R. Inventor, PhD, GNP, Assistant Professor, College of Nursing, Rush University, 600 S. Paulina Street, Suite 1080, Chicago, IL 60612; e-mail: Ben_Inventor@rush.edu.

Received: January 4, 2018

Accepted: March 13, 2018

doi:10.3928/02793695-20180503-04

TABLE A

RESIDENT ACTIVITIES, SOCIAL ENVIRONMENT, AND PSYCHOTROPIC MEDICATION USE IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

Variable	Sum, Mean[a] (*SD*)								
	Baseline			12 Months			24 Months		
	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Activity programs									
Structured	9,617, 110.5 (339.6)	6,136, 68.2 (339.6)	<0.0001	5,470, 81.6 (232.6)	4,122, 58.0 (232.6)	0.0005	3,304, 64.8 (166.0)	2,913, 48.5 (166.0)	0.007
Unstructured	8,779, 100.9 (339.9)	6,974, 77.5 (339.9)	0.002	5,325, 79.5 (233.9)	4,267, 60.1 (233.9)	0.004	2,877, 56.4 (168.4)	3,340, 55.7 (168.4)	0.91
Any group	9,696, 111.4 (340.8)	6,057, 67.3 (340.8)	<0.0001	5,476, 81.7 (234.6)	4,115, 58.0 (234.6)	0.0005	3,098, 60.7 (168.8)	3,119, 52.0 (168.8)	0.15
Small group	8,980, 103.2 (340.1)	6,773, 75.3 (340.1)	0.0003	5,359, 80.0 (233.8)	4,233, 59.6 (233.8)	0.003	2,872, 56.3 (168.4)	3,345, 55.7 (168.4)	0.93
Large group	9,554, 109.8 (339.5)	6,200, 68.9 (339.5)	<0.0001	5,394, 80.5 (231.3)	4,197, 59.1 (231.3)	0.001	3,343, 65.5 (166.0)	2,873, 47.9 (166.0)	0.003
Solitary	6,148, 70.7 (340.8)	9,606, 106.7 (340.8)	<0.0001	3,664, 54.7 (234.7)	5,928, 83.5 (234.7)	<0.0001	2,323, 45.5 (169.0)	3,894, 64.9 (169.0)	0.002
Care-related	8,081, 92.0 (340.7)	7,673, 85.3 (340.7)	0.32	4,934, 73.6 (234.7)	4,658, 65.6 (234.7)	0.24	3,182, 62.4 (169.0)	3,035, 50.6 (169.0)	0.054
Family visit	7,237, 83.2 (315.9)	8,516, 94.6 (315.9)	0.11	4,381, 65.4 (200.8)	5,210, 73.4 (200.8)	0.17	3,093, 60.6 (139.2)	3,123, 52.1 (139.2)	0.09

TABLE A (CONTINUED)

RESIDENT ACTIVITIES, SOCIAL ENVIRONMENT, AND PSYCHOTROPIC MEDICATION USE IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

Variable	Sum, Mean[a] (*SD*)								
	Baseline			12 Months			24 Months		
	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Social environment									
Location									
Off unit (observed)	5,861, 67.4 (339.9)	9,892, 109.9 (339.9)	<0.0001	3,957, 59.1 (232.8)	5,634, 79.4 (232.8)	0.003	2,838, 55.6 (165.7)	3,378, 56.3 (165.7)	0.92
Dining room	9,890, 113.7 (337.9)	5,863, 65.1 (337.9)	<0.0001	5,906, 88.1 (233.8)	3,686, 51.9 (233.8)	<0.0001	3,170, 62.2 (168.5)	3,046, 50.8 (168.5)	0.06
Common area	8,864, 101.9 (340.8)	6,890, 76.6 (340.8)	<0.001	4,941, 73.7 (234.4)	4,651, 65.5 (234.4)	0.22	2,527, 49.6 (168.8)	3,689, 61.5 (168.8)	0.052
Corridor	9,228, 106.1 (340.7)	6,525, 72.5 (340.7)	<0.0001	5,198, 77.6 (234.7)	4,393, 61.9 (234.7)	0.02	3,001, 58.8 (168.7)	3,216, 53.6 (168.7)	0.39
Bedroom (own)	5,778, 66.4 (340.8)	9,976, 110.8 (340.8)	<0.0001	4,041, 60.3 (234.7)	5,551, 78.2 (234.7)	0.009	2,889, 56.6 (169.0)	3,327, 55.5 (169.0)	0.85
Bedroom (other's)	9,543, 109.7 (298.3)	6,211, 69.0 (298.3)	<0.0001	5,314, 79.3 (210.6)	4,278, 60.2 (210.6)	0.002	3,144, 61.6 (144.1)	3,072, 51.2 (144.1)	0.05
Activity room	11,276, 129.6 (334.7)	4,478, 49.8 (334.7)	<0.0001	6,375, 95.1 (227.4)	3,217, 45.3 (227.4)	<0.0001	3,737, 73.3 (164.9)	2,479, 41.3 (164.9)	<0.0001
Shower/ bathroom	6,090, 70.0 (335.1)	9,664, 107.4 (335.1)	<0.0001	3,822, 57.0 (227.4)	5,770, 81.3 (227.4)	0.0002	2,693, 52.8 (157.0)	3,524, 58.7 (157.0)	0.30

TABLE A (CONTINUED)

RESIDENT ACTIVITIES, SOCIAL ENVIRONMENT, AND PSYCHOTROPIC MEDICATION USE IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

Variable	Sum, Mean[a] (*SD*)								
	Baseline			12 Months			24 Months		
	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Social proximity									
Individuals in area >10 feet	5,651, 65.0 (340.8)	10,102, 112.2 (340.8)	<0.0001	3,660, 54.6 (234.7)	5,932, 83.5 (234.7)	<0.0001	2,456, 48.1 (169.0)	3,761, 62.7 (169.0)	0.02
Individuals in area 3 to 10 feet	7,999, 91.9 (340.8)	7,755, 86.2 (340.8)	0.45	4,836, 72.2 (234.7)	4,756, 67.0 (234.7)	0.45	3,310, 64.9 (169.0)	2,906, 48.4 (169.0)	0.007
Individuals in area <3 feet	9,886, 113.6 (340.8)	5,868, 65.2 (340.8)	<0.0001	5,471, 81.7 (234.7)	4,120, 58.0 (234.7)	0.0005	2,965, 58.1 (169.0)	3,251, 54.2 (169.0)	0.52
Individuals present									
Staff	9,800, 112.6 (340.8)	5,954, 66.2 (340.8)	<0.0001	5,451, 81.4 (234.7)	4,140, 58.3 (234.7)	0.0007	3,011, 59.0 (169.0)	3,206, 53.4 (169.0)	0.36
Family	7,265, 83.5 (316.7)	8,489, 94.3 (316.7)	0.13	4,469, 66.7 (204.3)	5,122, 72.1 (204.3)	0.36	3,073, 60.2 (144.0)	3,144, 52.4 (144.0)	0.13
Residents	9,735, 111.9 (340.8)	6,019, 66.9 (340.8)	<0.0001	5,622, 83.9 (234.7)	3,969, 55.9 (234.7)	<0.0001	3,220, 63.1 (169.0)	2,996, 49.9 (169.0)	0.03
Others	8,653, 99.5 (340.8)	7,100, 78.9 (340.77)	0 .008	5,113, 76.3 (234.7)	4,478, 63.1 (234.7)	0.052	3,433, 67.3 (169.0)	2,783, 46.4 (169.0)	0.0006

TABLE A (CONTINUED)

RESIDENT ACTIVITIES, SOCIAL ENVIRONMENT, AND PSYCHOTROPIC MEDICATION USE IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

Variable	Sum, Mean[a] (*SD*)								
	Baseline			12 Months			24 Months		
	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Psychotropic medications used (%)									
Anxiolytic	11.5	8.9	0.57	3.0	12.7	0.04	3.9	11.7	0.14
Antidepressant	13.8	11.1	0.59	19.4	11.3	0.18	15.7	10.0	0.37
Antipsychotic	32.2	12.2	0.001	29.9	23.9	0.43	31.4	23.3	0.34
Hypnotic	1.2	5.6	0.11	4.5	4 (5.6)	0.76	3.9	1.7	0.47
Psychotropic medications used per person[b]			0.03			0.52			0.28
None	60.9	66.7		58.2	54.9		60.8	58.3	
One	23.0	30.0		28.4	36.6		25.4	36.7	
Two	12.6	2.2		11.9	8.5		11.8	5.0	
Three	3.5	1.1		1.5	0		2.0	0	

Note. SDCU = special dementia care unit; TNDU = traditional non-dementia unit.

[a] Proportion of observed minutes in which event occurred across all records (total events/observed minutes).

[b] Score range = 0 to 4.

TABLE B

RESIDENT BEHAVIORAL SYMPTOMS IN TWO FACILITIES AT BASELINE, 12 MONTHS, AND 24 MONTHS

Variable	Sum, Mean[a] (*SD*)								
	Baseline			12 Months			24 Months		
	SDCU (*n* = 87)	TNDU (*n* = 90)	Difference Between Groups (*p* Value)	SDCU (*n* = 67)	TNDU (*n* = 71)	Difference Between Groups (*p* Value)	SDCU (*n* = 51)	TNDU (*n* = 60)	Difference Between Groups (*p* Value)
Positive affect	7,637, 87.8 (340.7)	8,117, 90.2 (340.7)	0.76	4,572, 68.2 (233.3)	5,019, 70.7 (233.3)	0.72	2,962, 58.1 (168.5)	3,255, 54.2 (168.5)	0.53
Negative affect	8,088, 93.0 (336.5)	7,666, 85.2 (336.5)	0.31	5,391, 80.5 (228.4)	4,201, 59.2 (228.4)	0.001	3,111, 61.0 (167.0)	3,106, 51.8 (167.0)	0.13
Solitary behavior	8,846, 101.7 (340.8)	6,907, 76.7 (340.8)	0.001	5,053, 75.4 (234.7)	4,539, 63.9 (234.7)	0.09	2,915, 57.2 (169.0)	3,301, 55.0 (169.0)	0.73
Stimulation seeking	8,210, 94.4 (340.8)	7,543, 83.81 (340.8)	0.17	4,992, 74.5 (234.7)	4,600, 64.8 (234.7)	0.15	3,033, 59.5 (169.0)	3,184, 53.1 (169.0)	0.30
Verbal aggression	8,128, 93.4 (324.6)	7,625, 84.7 (324.6)	0.24	5,436, 81.1 (222.7)	4,155, 58.5 (222.7)	0.0005	3,058, 60.0 (155.1)	3,159, 52.6 (155.1)	0.19
Physical aggression	8,801, 101.2 (244.7)	6,953, 77.3 (244.7)	<0.0001	5,484, 81.9 (184.7)	4,107, 57.8 (184.7)	<0.0001	3,208, 62.9 (140.5)	3,008, 50.1 (140.5)	0.01
Any aggression	8,437, 97.0 (327.5)	7,317, 81.3 (327.5)	0.03	5,566, 83.1 (224.8)	4,026, 56.7 (224.8)	<0.0001	3,133, 61.4 (160.1)	3,083, 51.4 (160.1)	0.08
Positive behaviors	7,880, 90.6 (340.8)	7,873, 87.5 (340.8)	0.69	5,009, 74.8 (234.7)	4,582, 64.5 (234.7)	0.13	2,793, 54.8 (169.0)	3,423, 57.1 (169.0)	0.71
Negative behaviors	8,311, 95.5 (340.8)	7,442, 82.6 (340.8)	0.10	5,042, 75.2 (234.7)	4,550, 64.1 (234.7)	0.10	3,066, 60.1 (169.0)	3,150, 52.5 (169.0)	0.22
Total positive behaviors	7,613, 87.5 (340.8)	8,140, 90.4, (340.8)	0.70	4,898, 73.1 (234.7)	4,693, 66.1 (234.7)	0.30	2,799, 54.9 (169.0)	3,418, 57.0 (169.0)	0.74
Total negative behaviors	8,105, 93.2 (340.8)	7,648, 85.0 (340.8)	0.29	5,024, 75.0 (234.7)	4,567, 64.3 (234.7)	0.12	3,063, 60.1 (169.0)	3,153, 52.6 (169.0)	0.22

Note. SDCU = special dementia care unit; TNDU = traditional non-dementia unit.

[a] *Proportion of observed minutes in which event occurred across all records (total events/observed minutes).*