Windows to Their World: The Effect of Sensory Impairments on Social Engagement and Activity Time in Nursing Home Residents

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This study examined relationships between three sensory and communication abilities and two areas of nursing home resident behavior. Data from 18,873 nursing home residents include measures of hearing, visual, and communication abilities, and social engagement and time spent in activities. Increasing level of visual impairment is associated with low levels of social engagement and low time in activities. Both moderate and severe hearing impairment are associated with low time in activities, while inadequate communication is associated with limits in both social engagement and time in activities. The combined effects of visual and communication impairments are associated with low social engagement. Increased attention to sensory and communication losses may lead to improved quality of life in this population.

Hearing, vision, and communication abilities play important roles in older adults' capacity to develop and maintain relationships, to participate in activities, and to preserve a healthy sense of self and well-being (Heinemann et al., 1988; Horowitz, 1994; Lubinski, Morrison, and Rigrodsky, 1981; Marx et al., 1992; Meyerson, 1976; Rudberg et al., 1993; Weinstein and Ventry, 1982). These abilities provide a "window" through which older adults give and receive information. Without them, healthy functioning may be substantially reduced, or even eliminated (Meyerson, 1976; Selikson, Damus, and Hamerman, 1988; Verbrugge and Patrick, 1995). In the nursing home setting, where opportunities for social interaction are already limited, impairments in sensory and communication abilities may affect residents' quality of life by contributing to isolation from peers and staff, and by reducing social initiatives.

Previous research focusing on community-dwelling elders has shown that visual impairment is associated with limitations in activities of daily living (ADLs), instrumental activities of daily living (IADLs), reduced participation in leisure activities, and emotional disability (Branch, Horowitz, and Carr, 1989; Ford et al., 1988; Heinemann et al., 1988; National Center for Health Statistics, 1986). In the nursing home setting, Horowitz (1994) and Marx et al. (1992) showed significant, independent associations between visual impairment and ADL disability.

The magnitude of visual impairment in nursing homes is considerable: National data indicate that the prevalence of visual deficits among nursing home residents is 24 percent (National Center for Health Statistics, 1989), while a study by Tielsch and colleagues (1995) found 19 percent of residents have vision problems. The difference in prevalence estimates can be partly explained by different definitions of visual impairment as well as different data sources: Estimates from smaller studies, such as the one conducted by Tielsch et al., are often based on data from detailed eye examinations, while national data are collected by nurses or from medical records. As Horowitz (1994) points out, accurate information on nursing home residents' visual status is scarce because eye examinations are not conducted regularly. The absence of accurate data may reduce the ability of staff to identify emerging visual problems, as well as their ability to address the changing visual needs of residents.

As does visual impairment, hearing loss may influence the level and quality of interactive experiences of older adults. Two community-based studies focusing on social involvement and ADL disability among older people (Norris and Cunningham, 1981; Rudberg et al., 1993) showed that neither of these outcomes was affected by hearing loss. Norris and Cunningham reported that hearing loss was not associated with social involvement among men and women aged 60 years and older, while Rudberg and colleagues reported that a crude association between hearing impairment and increasing level of ADL disability after four years was reduced to nonsignificance after adjustment for demographic factors and chronic conditions. In contrast to these findings, Weinstein and Ventry (1982) found a significant association between hearing impairment and social isolation in a community-based sample of older adults. Such conflicting results suggest that the relationship between hearing loss and (at least) social function among community-dwelling elders warrants further investigation.

In a study focusing on nursing home residents, Garahan et al. (1992) reported that the prevalence of moderate to severe hearing loss was 51 percent, while another study reported that 22 percent of nursing home residents had moderate to severe hearing loss (Voeks et al., 1990). Differences in measurement and classification of hearing impairment may partly explain the dissimilar findings. Despite differing estimates of the prevalence of significant hearing impairment, both studies clearly show that hearing loss is highly prevalent in the nursing home population. As Rizzolo and Snow (1989) point
out, hearing impairment may affect nursing home residents in a variety of ways. It may reduce social interaction between residents, and between residents and staff; it may interfere with the ability of staff to obtain medical or other information from residents; if hearing loss is combined with cognitive impairment, a resident may be identified as more demented than he or she truly is. Hearing loss may also greatly enhance feelings of helplessness, passivity, and depression among nursing home residents, thereby reducing their ability or willingness to take advantage of the social situations and activities available to them. Overall, hearing impairment may contribute to the establishment and maintenance of a pattern of limited social interaction.

Impairments in spoken communication, which encompass factors such as respiration, articulation, and language, are more difficult to measure than losses in vision and hearing. Meyerson (1976), citing a collection of biological and social factors, claims that communication in older adults is ultimately evaluated by the ability to articulate and to make oneself understood through speech. Nursing home residents must be able to express needs to staff and to share experiences with one another. Lubinski, Morrison, and Rigrodsky (1981) explain that “The communicator chooses a system (means) to send his message — he may speak/write, gesture, sign, and so forth . . . the transmission and reception of the message is influenced not only by the sender and receiver, but also by the environment in which they communicate. The interactants are influenced by the natural and man-made phenomena of their physical environment, and more importantly, by the sociocultural milieu which generates rules governing interaction. Communication is therefore viewed as a personal act occurring in a psychological, social and physical panorama” (p. 405). Sigman (1985) adds that institutional expectations, and norms of staff/resident communication may help shape residents’ experiences inside the institution. For example, if residents perceive staff members as “too busy to talk,” they might not initiate conversations or build relationships in the institution. Conversely, if staff members see residents sitting quietly for long periods of time, either in a hallway or alone in a room, and fail to greet or invite them to participate in an activity, another opportunity for communication and social interaction is lost. Communication impairment may therefore diminish quality of life by reducing residents’ ability to establish and maintain social relationships and to take advantage of activities that require verbal expression.

To help understand how sensory and communication problems may influence quality of life in nursing homes, this study describes the association between these impairments and two outcomes: social engagement and time in activities. Improved understanding of these relationships may help caregivers identify sensory and communication profiles that place nursing home residents at increased risk of social isolation.

Social engagement. — In brief, much of the past work on social involvement has focused on community-dwelling men and women and has measured outcomes such as social ties (Brook et al., 1983) and frequency of contacts with friends and relatives (Willey and Silliman, 1990). In the nursing home setting, Reid and Washington (1984) measured the degree to which the social needs of residents were being met, whereas other evaluation methods have focused on negative social behaviors (Gurel, Linn, and Linn, 1972; Wilkinson and Graham-White, 1980).

Mor and colleagues’ study (1995) of social engagement addressed the need for a means to measure residents’ ability to take advantage of opportunities for social interaction in the nursing home setting. This study showed high internal consistency of six aspects of social engagement, and demonstrated that these items measured a single construct that reflects actual participation in the life of the home. Moreover, the items were shown to be robust across groups of residents who had a variety of ADL-cognitive statuses. Mor’s social engagement measures focus on positive behaviors and reflect a resident’s ability to take advantage of opportunities for social interaction, as well as the capacity to initiate this interaction. The measures include: being at ease interacting with others; at ease doing planned or structured activities; at ease doing self-initiated activities; establishing one’s own goals; pursuing involvement in life of the facility, and accepting invitations into most group activities. We hypothesize that greater sensory and communication impairments are associated with lower levels of social engagement.

Time in activities. — Our interest in the relationship between sensory and communication impairments and function extends beyond level of social engagement to the actual amount of time residents spend involved in activities. [See Lawton (1985) for a review of older adults’ activity and leisure time and Voelkl et al. (1995) for a thoughtful discussion of the benefits of activities for nursing home residents.] It is important to note that there is much variation across nursing homes in the extent to which facilities provide opportunities for residents to interact with others in activities. These differences may be associated with the clientele served by the facility, where homes serving “privileged” residents provide more opportunities, and those serving less affluent, or minority residents provide fewer. Previous research detailing the effects of activities on nursing home resident outcomes has shown that interventions involving exercises, music, and video games improve residents’ ambulation and mental health (Buettner, 1988; McGuire, 1984; Wolfe, 1983). Given the clear, positive impact of activity programs on nursing home residents, Federal law mandated that facilities provide “... activities designed to meet the interests and the physical, mental, and psychosocial well-being of each resident ...” (U.S. Congress, 1987). In response, Voelkl et al. identified personal characteristics such as gender, level of cognitive performance, and level of physical function as predictors of the amount of time residents spend involved in activities. This study builds on Voelkl’s work, and examines the hypothesis that residents with greater sensory and communication impairments will spend less of their time involved in the facility’s activities.

METHODS

Minimum Data Set

Data for this study were drawn from the University of
Michigan Archives of the Resident Assessment Instrument (RAI), a federally mandated assessment and care planning system for nursing homes. The basis of this system is the Minimum Data Set (MDS), a multidimensional assessment which is used on admission and annually thereafter, or when a significant change occurs in the resident’s status. The MDS is designed to capture measures of physical health, functional status, and psychosocial well-being. MDS data are collected by trained nurses using all possible sources of information, including medical records, the resident, and staff. Development and evaluation of the MDS and RAI are described in detail elsewhere (Morris et al., 1990, 1991). Despite some skepticism regarding use of MDS in formal research (Teresi and Holmes, 1992), the data are accurate and reliable; key aspects of the MDS have been validated against conventional measurement instruments (Friederksen, Tariot, and DeJonghe, 1996; Hartmaier et al., 1995; Hawes et al., 1992; Morris et al., 1990).

The sample for this analysis consists of 18,873 assessments from Pennsylvania nursing home residents. All assessments were performed in 1993, and no two assessments report information for the same individual.

Outcome Variables

This study focuses on two outcomes: social engagement and time in activities. The primary source of these measures is the resident, although staff members who have regular contact with the resident may also be consulted (Morris et al., 1991). A dichotomous variable for hearing (adequate vs all levels of impairment combined) is used in interaction models to represent each increasing level of hearing difficulty. Residents with adequate hearing are used as the reference group. A dichotomous variable for hearing (adequate vs all levels of impairment combined) is used in interaction models to simplify interpretation of parameter estimates.

It is important to note that use of hearing aids was purposefully left out of the analyses. This omission helped maintain consistency of the RAI hearing measure, which evaluates hearing “with hearing aid if used.”

Vision. — Visual impairment is assessed by an ordinal variable (adequate, minimal impairment, moderate impairment, severe impairment) that evaluates a resident’s ability to see close objects in adequate lighting, using any visual appliances for close vision (e.g., glasses, magnifying glass). Adequate lighting is defined as what is sufficient or comfortable for a person with normal vision (Morris et al., 1991). Visual ability is represented by three dummy variables (minimal, moderate, and severe visual impairment) indicating increasing levels of visual difficulty. Residents with adequate vision are used as the reference group. A dichotomous variable for visual ability (adequate vs all levels of impairment combined) is used in interaction models. Since vision is evaluated “in adequate light, with glasses if used,” use of corrective lenses was not included in analyses.

Communication. — Constructing a variable representing adequate or inadequate communication abilities was more challenging than constructing variables for vision or hearing. Consistent with Meyerson (1976) and Lubinski, Morris, and Rigrodsky (1981), we hypothesize that “adequate” communication incorporates both the ability to produce verbal speech as well as the capacity to make one’s speech understood by others. If, for example, a nursing home resident can produce sound verbally, but not make him/herself understood by peers and staff, the ability to make these sounds would not enhance this resident’s level of
functioning with respect to the outcomes of interest in this study. Similarly, if a resident can make him/herself understood by others using methods other than speech (e.g., gestures, use of a communication board), we hypothesize that this resident would also experience worse outcomes compared to those who use conventional verbal communication, which is quicker and easier to use and to understand.

To capture these dimensions with available information, a dichotomous variable that encompasses the two conditions was constructed. First, a resident’s primary mode of communication is defined (e.g., speech, gestures, communication board), indicating the type of communication used to make his or her needs and wishes known. Second, residents' ability to be understood by others is determined by the ability to express or communicate requests, needs, opinions, urgent problems, and participate in social conversations (Morris et al., 1991). For example, if a resident’s primary mode of expression is speech, and she is able to make herself understood by others, then the resident is coded as having “adequate” communication abilities. Inadequate communication includes those who do not communicate with speech, and residents who use speech but are unable to make themselves understood by others.

Covariates

Cognitive status. — It is well-documented that cognitive status is strongly associated with level of function in nursing home residents (Chiodo et al., 1994; Engle and Graney, 1993; Kane et al., 1983; Morris et al., 1994; Osterweil et al., 1994; Phillips and Hawes, 1992; Weber, Brown, and Weldon, 1978). Because we hypothesize that cognitive status confounds the relationship between sensory and communication impairments and the outcomes in this study, the MDS Cognitive Performance Scale (CPS) was used to control for the effects of cognition level. The CPS, a 7-level variable constructed from the MDS, is highly predictive of the Mini-Mental State Exam (Folstein, Folstein, and McHugh, 1975). The derivation and validation of the CPS have been described in detail elsewhere (Hartmaier et al., 1995; Morris et al., 1994). For this study, the CPS is modified slightly by collapsing the two highest levels of cognitive disability into a single level to accommodate the ADL variable for eating. Had this variable been used in multivariate models to describe both the CPS and ADLs, parameter estimates for both of these groups of variables would have been misleading. Five dummy variables are constructed for increasing level of cognitive disability, using no impairment as the reference (CPS1, CPS2 ... CPS5).

Chronic conditions. — The presence of chronic conditions can confound the relationship between the effects of sensory and communication impairments and the outcome measures. Previous research indicates that these conditions play a role in ADL disability in nursing home residents and in activity levels among community-dwelling adults (Horowitz, 1994; Verbrugge and Patrick, 1995). To control for chronic conditions, dichotomous variables for heart disease (heart), musculoskeletal and joint pain (bones), and lung disease (lung) represent presence of any condition within each group. For instance, lung is coded “yes” if chronic obstructive pulmonary disease or pneumonia is present. These summary indicators do not provide information on the joint effects of more than one condition in each disease group. However, the advantages of this coding scheme are to reduce the number of independent variables and to increase parsimony in multivariate models. Moreover, since the associations between chronic conditions and the outcomes are to be controlled, not described, use of summary indicators is most appropriate.

Age and race. — Age is measured in years. Since the prevalence of severe visual impairment is different across racial groups (Tielsch et al., 1995), it is necessary to address the potential confounding effects of race on social engagement and time in activities. Race/ethnicity is therefore represented by a series of indicator variables for American Indian and Alaska Natives (Indian), residents of Asian origin (Asian), those of African American descent (Black), and Hispanic residents (Hispanic). Caucasian residents were coded as the reference group.

Activities of daily living. — The heterogeneity of ADL measures is partially preserved by constructing three dichotomous ADL summary variables from the seven available in the MDS: early-loss ADLs, late-loss ADLs, and locomotion (Williams et al., 1994). The dichotomies distinguish between residents who are independent or who need some ADL supervision, and those needing all higher levels of ADL support (e.g., those who need limited or extensive assistance, or residents who are completely dependent). The goal of this categorization is consistent with that described for the outcomes: to distinguish residents who demonstrate ADL limitation at approximately the midpoint of the spectrum of possible response categories from those with less limitation.

Early ADL includes ADL measures for dressing and personal hygiene, two abilities in the realm of personal care that tend to be lost first. Residents requiring assistance or who are totally dependent in either of these ADLs are defined as “limited.” Late ADL includes four variables: toileting, transfer, bed mobility, and eating. These abilities are generally lost later than personal hygiene and dressing. Residents are coded as limited if they require assistance in three or four late-loss ADL activities. The cutpoints for both early- and late-loss ADLs are based on the concept that the resident had to exhibit considerable limitation, that is, limitation in approximately half of the ADLs in each group. The third ADL variable, locomotion, measures residents’ ability to move about their proximate environment. For this activity, residents are coded as limited if they require assistance, or are totally dependent in locomotion.

It is important to emphasize that the relationship between sensory and communication impairments and ADL disability is not of central interest in this study. Rather, summary ADL variables allow reduction of the number of independent variables in multivariate models, while still controlling for the confounding effects of ADL status.
Statistical Analysis

Because the effects of cognitive status, chronic conditions, level of ADL support, age, gender, and race may confound the relationship between sensory and communication impairments and levels of social engagement and time in activities, measures of association using the chi-square statistic for categorical data are calculated between each potential confounder and the predictors and outcomes separately. If a potential confounder is associated with both the predictor and the outcome, it is identified as a true confounder and entered into multivariate models for further evaluation. Because of the large sample size, a significance level of ($\alpha = .01$) is selected as the model entry criterion for confounding variables.

The logistic regression model was used to obtain prevalence odds ratios (POR) and 95 percent confidence intervals (CI) describing how hearing, vision, and communication impairments are associated with social engagement and time in activities, adjusted for confounders. The models describe a linear relationship between the explanatory variables and the log prevalence odds of each of the two outcomes. Wald $\chi^2$ statistics and corresponding $p$-values are used to evaluate the significance of individual model parameters, the likelihood ratio statistic determines the most parsimonious reduced models, and the Hosmer-Lemeshow (H-L) test assesses the goodness-of-fit of the final models. Further discussion of this model is available elsewhere (Agresti, 1990; Hosmer and Lemeshow, 1989; Selvin, 1991).

Several logistic models are explored. The first set of models (Model I) assesses main effects and includes the ordered sensory ability variables and confounders (age, race, gender, cognitive status, chronic conditions, and ADLs). An assumption of Model I is that the effect of any one independent variable is the same across all levels of the other independent variables. For example, Model I assumes that the effect of visual impairment on social engagement and time in activities is the same regardless of the level of hearing deficit. In contrast, Model II includes interaction terms (Hearing $\times$ Vision, Hearing $\times$ Communication, and Vision $\times$ Communication) which allow the effect of each dichotomous sensory and communication variable to vary according to the levels of the other two variables. Model II also includes the interaction of cognitive status and ADL dependence. Additional discussion on calculation and interpretation of interaction terms from the logistic model is provided by Hosmer and Lemeshow (1989). Finally, models using the four-level hearing and vision variables and the communication variable are analyzed with interaction terms for ADL dependence and each of five levels of cognitive impairment (Model III). Models I-III were analyzed separately for both social engagement and time in activities, and the best-fitting, most parsimonious models were identified. Results from all three models are reported.

RESULTS

Demographic Information

Table 1 shows demographic and health characteristics of the sample. Residents' mean age is 82.1 years, more than 75 percent of residents are female, and 92 percent are White. Among non-Whites, Blacks are most highly represented (6.5%), followed by American Indians, Hispanics, and Asians. Non-White, non-Black residents compose a total of 1.1 percent ($n = 213$) of the total sample. This sample is typical of the demographic breakdown of the U.S. nursing home population.

Nearly 64 percent of the sample have at least one chronic heart condition, 34 percent have a musculoskeletal condition, and 15 percent have a chronic lung condition. The high prevalence of heart disease in this nursing home sample mirrors a long-standing trend in the noninstitutionalized population. Levels of cognition measured by the Cognitive Performance Scale are distributed about evenly among the three highest and three lowest categories. Eighteen percent of the sample are intact, and 25 percent are either borderline intact or have mild impairment. The upper end of the CPS showed a similar distribution: Thirty-two percent of the sample were either severely or very severely impaired, and 25 percent have either moderate or moderate-severe impairment. Nearly 77 percent of the sample have at least one early ADL impairment, 55 percent have 3 or more late ADL impairments, and 61 percent are limited in locomotion.

<table>
<thead>
<tr>
<th>Variable</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean = 82.1 ($SD = 10.6$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female gender</td>
<td>75.7</td>
<td>14,278</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>92.0</td>
<td>17,380</td>
</tr>
<tr>
<td>Black</td>
<td>6.5</td>
<td>1,240</td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>0.5</td>
<td>102</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.4</td>
<td>76</td>
</tr>
<tr>
<td>Asian</td>
<td>0.2</td>
<td>35</td>
</tr>
<tr>
<td>Chronic Conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart</td>
<td>63.9</td>
<td>12,076</td>
</tr>
<tr>
<td>Bones</td>
<td>34.3</td>
<td>6,469</td>
</tr>
<tr>
<td>Lung</td>
<td>15.0</td>
<td>2,833</td>
</tr>
<tr>
<td>Cognitive Status</td>
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<td></td>
</tr>
<tr>
<td>Intact</td>
<td>18.4</td>
<td>3,476</td>
</tr>
<tr>
<td>Borderline intact (CPS1)</td>
<td>15.8</td>
<td>2,989</td>
</tr>
<tr>
<td>Mild impairment (CPS2)</td>
<td>8.8</td>
<td>1,664</td>
</tr>
<tr>
<td>Moderate impairment (CPS3)</td>
<td>19.4</td>
<td>3,658</td>
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<tr>
<td>Moderate-severe impairment (CPS4)</td>
<td>5.7</td>
<td>1,076</td>
</tr>
<tr>
<td>Severe + very severe impairment (CPS5)</td>
<td>31.8</td>
<td>5,995</td>
</tr>
<tr>
<td>ADL Status*</td>
<td></td>
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</tr>
<tr>
<td>Limited in $\geq$1 early ADL*</td>
<td>76.7</td>
<td>14,484</td>
</tr>
<tr>
<td>Limited in $\geq$2 late ADL*</td>
<td>54.6</td>
<td>10,303</td>
</tr>
<tr>
<td>Limited in locomotion</td>
<td>60.5</td>
<td>11,383</td>
</tr>
</tbody>
</table>

*Percent totals may not add to 100.0 because of missing data or rounding.

Presence of arteriosclerotic heart disease, congestive heart failure, cardiac dysrhythmias, hyper/hypotension, or other heart disease.

Presence of arthritis, osteoporosis, peripheral vascular disease, or joint pain.

Presence of chronic obstructive pulmonary disease or pneumonia.

Independent + limited supervision vs limited assistance + extensive assistance + total dependence.

Early ADLs: dressing and personal hygiene.

Late ADLs: toileting, transfer, bed mobility, and eating.
establishes own goals; pursues involvement in life of facility; accepts
original ordered variable is: 0 measures, 29.5%; 1 measure, 22.4%; 2
doing planned or structured activities; at ease doing self-initiated activities;
time, 7.2%.
measures, 16.4%; 3 measures, 12.3%; 4 measures, 8.1%; 5 measures,
rounding.

Sensory and Communication Impairments, Social
Engagement, and Time in Activities

Table 2 presents frequency distributions of the outcomes and the exposures of primary interest. The distribution of levels of sensory and communication impairments is similar for each of the four levels of hearing and vision, with the greatest proportion of residents having adequate hearing and visual abilities. For instance, 65 percent of the sample have adequate hearing, and 55 percent have adequate vision. Thirty-one percent of the sample have minimal or moderate hearing impairment, and 40 percent have minimal or moderate visual impairment. Residents with severe visual or severe hearing impairment make up the smallest proportion of the sample. In this group, 3 percent have severe hearing impairment, and 4 percent have severe visual impairment.

<table>
<thead>
<tr>
<th>Variable</th>
<th>%a</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate: Sees fine detail, including regular print in newspapers</td>
<td>55.3</td>
<td>10,439</td>
</tr>
<tr>
<td>Minimal Impairment: Sees large print, but not regular print</td>
<td>30.2</td>
<td>5,704</td>
</tr>
<tr>
<td>Moderate Impairment: Limited vision; unable to see headlines</td>
<td>9.4</td>
<td>1,767</td>
</tr>
<tr>
<td>Severe Impairment: No vision, or appears to see only light or shapes</td>
<td>4.3</td>
<td>819</td>
</tr>
<tr>
<td>Hearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate: Normal talk, TV, telephone</td>
<td>64.9</td>
<td>12,245</td>
</tr>
<tr>
<td>Minimal Impairment: Minimal difficulty when not in normal setting</td>
<td>22.3</td>
<td>4,182</td>
</tr>
<tr>
<td>Moderate Impairment: Hears in special situations only</td>
<td>9.1</td>
<td>1,732</td>
</tr>
<tr>
<td>Severe Impairment: Absence of useful hearing</td>
<td>3.1</td>
<td>593</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate: Uses speech, and able to make self understood</td>
<td>65.9</td>
<td>12,435</td>
</tr>
<tr>
<td>Inadequate: Does not use speech, or unable to make self understood</td>
<td>33.5</td>
<td>6,319</td>
</tr>
<tr>
<td>Social Engagementb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–2 measures present</td>
<td>68.3</td>
<td>12,889</td>
</tr>
<tr>
<td>3–6 measures present</td>
<td>31.6</td>
<td>5,962</td>
</tr>
<tr>
<td>Time in Activitiesc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None or little</td>
<td>49.3</td>
<td>9,320</td>
</tr>
<tr>
<td>Some or most</td>
<td>50.6</td>
<td>9,553</td>
</tr>
</tbody>
</table>

Table 2. Description and Distribution of Sensory Impairments and Functional Outcome Measures

*Percent totals may not add to 100.0 because of missing data points or rounding.

The trend toward adequate abilities is observed for communication, with 66 percent of residents having adequate communication. A majority of residents have adequate abilities in all three sensory and communication areas; a smaller proportion of residents have adequate vision compared to adequate hearing and adequate communication. When considering presence or absence of the three sensory abilities as a group, 31 percent of the sample have no impairment in any of the three sensory and communication areas, while 23 percent of the sample have at least some impairment in all three areas (data not shown). However, there is considerable variation in the number of sensory and communication impairments exhibited by nursing home residents.

Although 31 percent of the sample have adequate abilities in each of the three sensory and communication areas, a substantial proportion of the sample exhibit low social engagement and low time in activities. Sixty-eight percent of the sample exhibit two or fewer measures of social engagement, and almost half spend no more than one-third of their time involved in activities. The proportion of residents with low social engagement (68%) is somewhat larger than the proportion of residents who spend little or no time in activities (49%). This raises the possibility that residents’ level of social engagement might not translate directly to the amount of time they actually spend in activities.

Bivariate analyses indicate that all variables listed in Table 1 except gender, heart, and lung disease are related to both sensory and communication abilities and to social engagement (α = .01), and are therefore entered as covariates in logistic models with social engagement as the outcome of interest. Similarly, all variables except gender and lung conditions are potential confounders of the relationship between sensory and communication abilities and time in activities, and are included in the logistic models for this outcome. Since gender is a logical confounder, it was left in the models despite the fact that it was not statistically significant in bivariate analyses.

Table 3 highlights prevalence odds ratios, and 95 percent confidence intervals (CIs) about the point estimates for the effect of each of the three sensory areas on low social engagement and low time in activities. The term "prevalence odds ratio" is used as a reminder of the cross-sectional study design. Odds ratios from logistic models in these analyses describe prevalent associations, not risk, nor odds. The parameter estimates are interpreted as the log odds of a resident being in the lower of the two outcome levels. Note that the confidence intervals constructed about the point estimates are tight, which suggests stable estimates and also reflects the large sample. Odds ratios and CIs are presented for main effects, while Beta coefficients and p-values are presented for interaction terms because these terms are uninterpretable without a corresponding main effect.

In Model I, increasing level of visual impairment is associated with decreasing levels of both social engagement and time in activities. Visual impairment is therefore associated with a gradient of low function in these two outcomes. Minimal visual impairment is associated with a 19 percent greater prevalence of low social engagement (POR = 1.19; CI = 1.09, 1.82), whereas moderate and severe visual impairment are associated with 40 percent and 51 percent.
Adequate vs impaired hearing

Vision x Communication

Adequate vs impaired vision

Hearing x Communication

Variable | Social Engagement | Time in Activities
---------|------------------|------------------
         | Model I*         | Model II*        | Model I*         | Model III*
         | Prevalence Odds Ratio (95% CI) | Prevalence Odds Ratio or β* (95% CI or p-value) | Prevalence Odds Ratio or p-value | Prevalence Odds Ratio or β* (95% CI or p-value)
Hearing
Minimal impairment | 0.99 (n.s.) | 1.04 (n.s.)
Moderate impairment | 1.09 (n.s.) | 1.15 (1.03, 1.29)
Severe impairment | 1.42 (1.10, 1.83) | 1.30 (1.08, 1.57)
Vision
Minimal impairment | 1.19 (1.10, 1.29) | 1.15 (1.07, 1.23)
Moderate impairment | 1.40 (1.19, 1.63) | 1.51 (1.34, 1.69)
Severe impairment | 1.51 (1.23, 1.86) | 1.65 (1.41, 1.93)
Communication
Adequate vs impaired | 1.72 (1.51, 1.95) | 1.62 (1.38, 1.91)
Adequate vs impaired hearing | 1.02 (n.s.) | —
Adequate vs impaired vision | 1.18 (1.06, 1.31) | —
Hearing x Communication | n.s. | —
Vision x Communication | 0.216 (.03) | —
Early ADL x CPS1 | n.s. | —
Early ADL x CPS2 | n.s. | —
Early ADL x CPS3 | n.s. | —
Early ADL x CPS4 | n.s. | —
Early ADL x CPS5 | 0.873 < .001 | 0.882 < .001

*Confidence intervals are provided for the odds ratios of main effect variables. p-values are provided for interaction terms.

1Model I contains indicator variables for each of three levels of hearing and vision impairment. This model is adjusted for age, gender, musculoskeletal conditions, cognitive status, race, early- and late-loss ADLs, and locomotion. Time in activities is also adjusted for heart conditions. The Hosmer-Lemeshow goodness-of-fit χ² statistics are 24.763, p = .002 for social engagement and 19.299, p = .013 for time in activities.

2Model II contains dichotomous variables for hearing, vision, and communication that compare "adequate" abilities to all levels of impairment. This model also contains pairs of interaction terms for sensory abilities, and interaction terms between early loss ADLs and each level of cognitive impairment. Other covariates are the same as in Model I. The Hosmer-Lemeshow goodness-of-fit χ² statistic is 16.07, p = .041.

3Model III contains indicator variables for each of three levels of hearing and vision impairment, and interaction terms for early loss ADLs and each level of cognitive status. This model is adjusted for age, gender, musculoskeletal conditions, cognitive status, race, and ADLs. The Hosmer-Lemeshow goodness-of-fit χ² statistic is 10.53, p = .229.

4β-values, not odds ratios, are provided for interaction terms because interpretation of these estimates is dependent on the β-values of the main effects. The exponentiated sum of the two β coefficients yields the odds ratio for the joint effect of interest.

CPS = Cognitive Performance Scale of the Minimum Data Set.

greater prevalence of low social engagement, respectively (moderate visual impairment: POR = 1.40; CI = 1.19, 1.63; severe visual impairment: POR = 1.51; CI = 1.22, 1.86). The gradient of significant vision-related limitation is similar for the relationship between visual impairment and time in activities. Compared to adequate vision, minimal, moderate, and severe visual impairment are associated with 15 percent, 51 percent, and 65 percent greater prevalence of low time in activities. These results are consistent with Horowitz (1994) and Marx et al. (1992), who reported lower physical function among vision-impaired residents.

Under Model I, the effects of hearing impairment on the two outcomes are somewhat more attenuated than those for visual impairment. Minimal hearing impairment is not associated with low social engagement or time in activities. Moderate hearing impairment is unrelated to low social engagement, but is associated with 15 percent greater prevalence of low time in activities (POR = 1.15, CI = 1.02, 1.28). Severe hearing impairment, however, is associated with both low social engagement and low time in activities. At this level of hearing impairment, there is a 42 percent greater prevalence of low social engagement (POR = 1.42, CI = 1.09, 1.82), and 30 percent greater prevalence of low time in activities (POR = 1.30, CI = 1.08, 1.57). Hearing impairment appears to be related more closely to time in activities, where both moderate and severe hearing impairment are associated with low function, than to social engagement, where only the most severely impaired residents have low functioning. This suggests that in nursing homes, hearing is more strongly associated with the actual amount of time residents spend in activities, than their likelihood of exhibiting general initiative and involvement. These findings are consistent with those of Weinstein and Ventry (1982), who found that hearing impairment was associated...
with social isolation among older persons living in the community.

Like both visual and hearing impairment, presence of inadequate communication abilities is associated with lower levels of both social engagement and time in activities. Compared to adequate communication, inadequate abilities are associated with a 72 percent greater prevalence of low social engagement and a 27 percent greater prevalence of low time spent in activities. Although inadequate communication certainly appears to be associated with both outcomes, the dichotomous coding of this variable does not allow for a more detailed examination of a variety of levels of communication impairment. The "all or nothing" coding is partly reflected in the greater magnitude of its associated point estimate in the regression equations for both outcomes.

Although the gradient of odds ratios under Model I strongly suggests that the effects of sensory impairments are important in explaining the outcomes under study, the Hosmer-Lemeshow test indicated that Model I does not fully describe the data (H-L test for social engagement: \( \chi^2 = 24.763, p = .002 \); H-L test for time in activities: \( \chi^2 = 19.299, p = .013 \)). To address this, Models II and III are evaluated on each of the outcomes. Model II provides the best fit for social engagement, although it did not reach statistical significance (H-L test: \( \chi^2 = 16.07, p = .041 \)). This model includes dichotomous variables for each of the three sensory areas, an interaction term for the combined effects of visual and communication impairments, and an interaction term for early loss ADLs and the highest level of cognitive impairment. No other interaction terms are statistically significant in this model.

Under Model II, the effect of impaired hearing is not significant, while the main effect of impaired communication is significant (POR = 1.62, CI = 1.38, 1.91), as is the main effect of impaired vision (POR = 1.18, CI = 1.06, 1.31). The interaction of impaired vision and impaired communication is also significant in this model. This basic difference in model characteristics prevents an empirical comparison of the prevalence odds ratios for the sensory variables between Models I and II. It can be concluded with Model II that hearing impairment is less strongly associated with social engagement than either visual or communication impairment.

Using communication impairment and the interaction of Vision and Communication as an example, the main effect of the communication variable is interpreted as the influence of communication impairment on social engagement in the absence of visual impairment. To quantify the effect of the presence of both communication and visual impairment, the Beta coefficient of the interaction term is added to the natural log of the main effect variable (the Beta). In this example, to assess the effect of the presence of both vision and communication impairment on a resident with communication impairment, the Beta coefficient of the interaction term (\( \beta = .216 \)) is added to \( \ln(1.62) \). This sum is exponentiated to yield a prevalence odds ratio for a resident with both vision and communication impairment. In this example, a resident with both impairments would have a POR of 2.01. This odds ratio is considerably larger than the main effect for communication impairment alone (POR = 1.62), and illustrates the compounded effects of impairment in both vision and communication on prevalence of low social engagement.

In addition to the importance of the interaction of vision and communication impairment on level of social engagement, the interaction of early-loss ADLs and the highest level of cognitive impairment also increases the odds of a resident having a low level of social engagement. The coefficient of this term is large and highly significant (\( \beta = .873, p \leq .001 \)). The importance of this interaction term in the model confirms an intuitive hypothesis: that low social engagement is especially prevalent among nursing home residents with the highest levels of cognitive impairment who have also begun to lose basic physical abilities. No other interaction terms are significant in this model.

Refining the model fit for time in activities is accomplished with Model III by adding a single interaction term for limitation in early ADLs and the highest level of cognitive impairment. This model showed excellent fit for the data (H-L test: \( \chi^2 = 10.53, p = .229 \)). Under this model, the ordered sensory ability variables are retained, as is the gradient of prevalence odds ratios associated with each level of hearing and visual impairment. Note that the odds ratios for each of the three sensory and communication abilities remained virtually unchanged between Models I and III, highlighting the importance of the ordered variables in explaining level of time in activities, as well as the stability of the point estimates. As in Model II, the coefficient of the interaction term for early loss ADLs and cognitive impairment is large and highly significant (\( \beta = .882, p < .001 \)). No other interaction terms are significant in this model.

To determine if the grouping schemes (i.e., "2 or fewer measures of social engagement" and "little or no time" in activities) used to code the outcomes were influencing point estimates in the multivariate models, the outcomes were regrouped (i.e., "4 or fewer measures of social engagement" and "none, little, or some" time in activities) by increasing the cutpoints at which the outcomes are defined. The models in this sensitivity analysis yielded results similar to earlier ones. Although the point estimates for the sensory variables shifted somewhat, these changes do not substantially alter the results presented above. The gradient of low function associated with increasing level of visual impairment remains, as do associations between higher levels of hearing impairment and inadequate communication.

**Discussion**

The results from this study show strong prevalent associations between the effects of hearing, visual, and communication impairments and low levels of social engagement and time spent in activities in a large sample of nursing home residents. In a simple model that included ordered sensory abilities and no interaction terms, severe hearing impairment was associated with 42 percent greater prevalence of low levels of social engagement, and 30 percent greater prevalence of little or no time involved in activities. Similarly, presence of severe visual impairment was associated with 51 percent greater prevalence of low levels of social engagement, and 65 percent greater prevalence of little or no time involved in activities. Significant associations of lesser mag-
nitude were noted for all lower levels of visual impairment, and for moderate and severe hearing loss. In addition to highly significant prevalence odds ratios, a positive gradient of association between increasing level of sensory and communication impairments and both social engagement and time in activities was demonstrated.

This study indicates that it is important to consider a resident’s sensory and communication abilities when assessing social engagement and time in activities. Structural differences in the final models of these dependent variables suggest, however, that evaluation of hearing, vision, and communication should be approached separately for the two outcomes. Specifically, when evaluating social engagement, presence of any sensory or communication impairment can be used, whereas for time in activities, each level of both hearing and visual impairment should be considered. Additionally, attention should be given to the interaction of visual and communication problems when studying social engagement, because the combined effects of these two sensory abilities significantly increase the odds of low function.

When interpreting the effects of sensory and communication impairments on the outcomes explored here, the effects of environmental, staff, and other facility-related factors must be recognized. Using hearing as an example, Schow (1982) describes a variety of factors that are associated with hearing aid use, such as motivation of the resident, the resident’s tolerance for background noise that may accompany hearing aid use, and how much encouragement of aid-use residents receive from family and staff. Ney (1993) reported that 11 percent of subjects aged 60–101 had cerumen (ear wax) impaction in one or both ears, and adds that hearing examinations and checks for cerumen do not occur with regularity. Following the conclusion of Voeks et al. (1990) that the problem of hearing impairment should be addressed by management directives at the institutional level, Garahan et al. (1992) proposed a 7-item program for improving hearing care in nursing homes. The program calls for audiometric screening on admission, improved documentation of hearing problems, establishment of a wax-removal protocol, assignment of a trained nurse as hearing specialist, and environmental modifications such as carpeting and sound-absorptive window, wall, and ceiling treatments. Such modifications will begin to address the needs of hearing-impaired nursing home residents. Similar programs featuring practical steps to help improve vision and communication abilities are also needed.

The limitations of this study should be noted. First, the data are cross-sectional, and do not provide a temporal sequence for the observed association between sensory impairments and social engagement and time in activities. Results should not be interpreted in a cause-and-effect framework but should instead be regarded as a springboard for further investigation that incorporates a time-dependent, dynamic component.

Second, RAI measures of sensory and communication impairments are evaluated by a resident’s ability to do certain tasks (read a book, hear normal talk and television), and have not been validated against other measurement methods. It should be emphasized, however, that the purpose of these measures is to describe the impairments in terms of manifested behaviors. They are not meant to serve as proxies for specific medical conditions.

A third factor to consider is that use of categorization schemes such as adequate, minimal, moderate, or severe impairment are imperfect surrogates for the collection of biologic factors that are ultimately manifested as a resident’s ability, for example, to generate speech in a way others can understand. One might argue that interpretation of parameter estimates based on this scheme leads to erroneous conclusions about the relationships described here. If this were true, however, it is unlikely that the gradient of effects, such as that associated with visual impairment, would have been observed.

A logical next step is to determine if lower levels of social engagement and time in activities are only associated with sensory and communication impairments, or whether they are entirely or partly caused by them. As noted above, longitudinal analysis focusing on changes in these outcomes over time is needed to answer this question. One way to assess areas for potential improvement in the short term is to examine the relationship between higher levels of sensory impairment and use patterns of assistive devices. In our sample, 73 percent of residents with severely impaired hearing, and 75 percent of residents with moderate hearing impairment do not use assistive devices such as hearing aids. Similarly, 68 percent of residents with severely impaired vision, and 36 percent of residents with moderate visual impairment do not use eyeglasses or magnifying glasses. This suggests that future research should explore determinants of appliance use by nursing home residents, as well as staff characteristics or training that may be associated with encouraging maximal use of assistive devices among residents whose physical and cognitive abilities so permit.

A better understanding of sensory and communication impairments may contribute to improving quality of life for nursing home residents by helping staff to more easily identify residents with high-risk impairment profiles. This may increase the likelihood that the needs of these residents are met to the fullest extent possible.

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REFERENCES


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