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Quality of life of nursing-home residents with dementia subject to surveillance technology versus physical restraints: an explorative study.

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ABSTRACT

Objective: As physical restraints should only be used in exceptional cases, there is an urgent need for alternatives to restraint use. Surveillance technology could be such an alternative. This study explored whether nursing-home residents with dementia subjected to surveillance technology had better quality of life scores for mood, behavioral and societal dimensions than residents with physical restraints.

Methods: Quality of life was assessed longitudinally, with three measurements in six psychogeriatric nursing homes of residents with surveillance technology ($n = 170$) and residents with physical restraints ($n = 22$). QUALIDEM subscales were used to measure five dimensions of quality of life. Multilevel longitudinal univariate and multivariate regression techniques were used to analyze the data.

Results: Because physical restraints were almost exclusively used in residents with low activities of daily living (ADL) independency (18 of the 22), we restricted the regression analyses to residents with a Barthel Index score ≤ 5 (overall $n = 53$). Univariate results showed that highly ADL-dependent residents with surveillance technology had significantly more positive affect than highly ADL-dependent residents with physical restraints. However, this difference proved to be no longer significant after adjustment for the confounders: age, sex and stage of dementia.

Conclusions: Quality of life of highly ADL-dependent nursing-home residents with dementia seems to be unrelated to the use of surveillance technology as opposed to physical restraints.

INTRODUCTION

There is a worldwide consensus that physical restraints should only be used in exceptional cases. However, they are still frequently used on people with dementia living in nursing homes. Worldwide prevalence of physical restraints in nursing-home residents with dementia ranges from 41% to 64%; the prevalence of physical restraints in psychogeriatric nursing-home settings in the Netherlands is 56% (Hamers & Huizing, 2005). The exact definition of physical restraints is still subject to debate, but they have been described as “any limitations on an individual's freedom of movement” (Hantikainen, 1998) or “any measures used to restrict, restrain or prevent movement” (De Veer et al., 2009).

Although physical restraints may also be used to manage the more challenging behavioral symptoms of dementia, the most frequently stated reason for using them is to prevent wandering and falls (Hamers et al., 2004). Restraining residents with dementia in a bed or a chair, for example, with a Swedish belt or chair belt, is thought to prevent them from falls and subsequent injury. However, there is evidence that the use of physical restraints does not reduce the incidence of injuries (Neufeld et al., 1999). Moreover, physical restraints may have adverse effects on the quality of life of the people being subjected to them (Castle, 2006; Castle & Engberg, 2009). These findings have led to a general agreement on the need to reduce the use of physical restraints on people with dementia. However, achieving this reduction is often a difficult process (Huizing et al., 2009). This may be at least partly attributable to lack of information on alternatives to restraint use (Moore & Haralambous, 2007). Surveillance technology could be such an alternative. Surveillance technology is a specific type of assistive technology, of which various forms have already been designed and tested for people with dementia (Bharucha et al., 2009). Examples of surveillance technology are acoustic and visual monitoring systems, door sensors and infrared sensors in beds or chairs that detect movement and subsequently send an alarm to nursing staff. Other examples are chips sown into residents' clothing or shoes that are programmed to close or open doors, or use of the Global Positioning System (GPS) to assess the resident's location. Surveillance technology devices may give residents more freedom of movement, while still reassuring nursing staff that the residents are relatively safe.

An increasing number of nursing homes use some form of surveillance technology to monitor their residents. In a thematic literature review, Niemeijer et al. (2010) present several reports and case studies indicating that surveillance technology may be a viable alternative to physical restraints (e.g., Bail, 2003; Freeman, 2004; Alzheimer's Society, 2007; Moffat, 2008). In addition, some authors state that surveillance technology could and/or should improve the quality of life of residents (e.g. Cahill, 2003; Astell, 2006; Hughes, 2008). However, to our knowledge, just one study actually considered the quality of life of residents when surveillance technology is used (Lauriks et al., 2008); it showed that some aspects of residents' quality of life improved in group living home units where surveillance technology was used, compared with similar units without surveillance technology.

Therefore, further research is needed into the effects on the quality of life of surveillance technology versus physical restraints. However, quality of life is a multidimensional concept (Lawton, 1991), and some dimensions may be more influenced than others by the use of surveillance technology versus physical

restraints. It was expected that particularly dimensions pertaining to social interactions, mood and behavior could have more positive scores among residents with surveillance technology than among residents with traditional physical restraints, owing to the greater freedom of movement that surveillance technology provides.
This paper therefore explores the social, mood and behavioral dimensions of the quality of life of residents with surveillance technology compared with those of residents with physical restraints.

METHODS

Design

A non-experimental longitudinal design was used in which quality of life was assessed using three measurements, each with an interval of 2 months. We studied two groups of residents: those with one or more forms of surveillance technology and those with one or more forms of physical restraints.

Ethical issues

The study was approved by the Medical Ethics Committee of the VU University Medical Center Amsterdam. Family and/or guardians of all eligible residents could object in writing to their participation using a non-consent form they could send to the nursing home to ensure their privacy. Only a small number ($n < 10$) of non-consent forms were received.

Settings

In the Netherlands, nursing homes are publicly funded institutions in which people with psychogeriatric conditions such as dementia receive separate care from those with primarily somatic conditions. This study involved only psychogeriatric wards in nursing homes.
A purposive sample was formed, involving (a) three nursing homes that used one or more forms of surveillance technology and that had an institutional policy of using surveillance technology and (b) three nursing homes that only sporadically used surveillance technology. These six nursing homes were selected on the basis of expert advice (physicians and researchers in the field of nursing-home care) and data from a national survey on the use of surveillance technology in nursing homes by Niemeijer et al. (submitted).
The six participating nursing homes were heterogeneous in terms of geographical and accommodation characteristics. Three nursing homes were located in rural areas, whereas the other three were in urban areas. Three nursing homes had traditional living accommodation, whereas the other three had some form of group living care (Verbeek et al., 2008). Resident numbers ranged from 60 to 128, with a total of 594. The psychogeriatric wards in the six nursing homes employed 485 nursing staff members, composed of both registered nurses (RNs) and certified nurse assistants (CNAs) and nurse aides.

Sample

Residents were eligible for inclusion if they were subjected to one or more forms of surveillance technology or one or more forms of physical restraints.
A total of 221 residents participated in the study: 192 residents participated in the first measurement, 186 residents in the second measurement and 179 residents in the third measurement. One hundred fifty residents took part in all three measurements. The most common reason for attrition was mortality, with termination of the use of physical restraints or surveillance technology playing a minor role.
In the first measurement, the study groups consisted of 170 residents with surveillance technology and 22 residents with physical restraints. This ratio was approximately the same in the second and third measurements. About 30% of the residents with physical restraints were subjected to surveillance technology as well. However, we included these in the physical restraints group as we considered their physical restraints to have most influence on their quality of life. The most commonly given reason for using physical restraints was the prevention of falls (exact data not available).

Types of device and restraint studied

The following devices were defined as surveillance technology: surveillance cameras, acoustic monitoring systems, chips worn in clothing or shoes that close doors or sound an alarm when off-limits doors are opened, tracking chips with GPS, inactivity sensors, movement sensors in beds or chairs, door sensors and bed pressure sensors. Physical restraints were defined in this study as measures that involved fixation: fixation by using deep chairs, chairs with a tabletop, chairs placed against a table and fixation in bed or chairs with belts or restraining blankets. Table 1 presents the types and numbers of surveillance technology devices and physical restraints in the two study groups.

[TABLE 1]

MEASURES

Resident characteristics

In this study, resident characteristics were defined as age, sex, severity of dementia, independence in activities of daily living (ADL) and behavioral problems.
The Global Deterioration Scale (Reisberg, 1983; 2007) was used to measure severity of dementia. This observational scale describes seven distinct progressive stages of dementia, with a score of 1 reflecting no dementia and a score of 7 reflecting severe dementia.
The Barthel Index (Mahoney & Barthel, 1965) was used to measure independence in ADL. This observational scale is widely used to assess ADL in older people (Burns et al., 1999). Its reliability, validity and sensitivity have been researched extensively and are considered excellent (Collin et al., 1988, Wade & Collin, 1988). The scale consists of 10 ADL domains, with a minimum score of 0 and maximum score of 20. A higher score indicates more independence in ADL. Cronbach's alphas for the three measurements in this study were 0.87, 0.88 and 0.86, respectively.
Behavioral disturbances were assessed by using the Neuropsychiatric Inventory Questionnaire-Nursing Homes (NPI-NH), which is a slightly modified version of the

Neuropsychiatric Inventory (Cummings et al., 1994), a widely used and well-validated observational instrument for examining psychopathology in dementia (Burns et al., 1999; De Jonghe et al., 2003). The 12 items in this scale each measure a neuropsychiatric symptom on a four-point scale. A higher score indicates greater symptom severity. Cronbach's alphas for the three measurements in this study were 0.62, 0.70 and 0.69, respectively.
Behavioral problems were also measured by using two subscales from the Minimum Data Set of Resident Assessment Instrument (RAI; Morris et al., 1990), a reliable and well-validated observational instrument (Achterberg et al., 1999). The Mood and Behavior subscales were used in this study. The Mood subscale has 11 items (Cronbach's alpha of 0.75, 0.78 and 0.77 for the three measurements). The Behavior subscale has six items (Cronbach's alpha of 0.63, 0.63 and 0.66 for the three measurements). All items have a four-point scale, with a higher score indicating greater severity.

Quality of life

QUALIDEM was used to measure quality of life. This is an observational scale that assesses the quality of life of people with dementia in nursing-home care. It has sufficient validity and reliability (Ettema et al., 2007a, 2007b). This scale assesses nine dimensions of quality of life in dementia. We used the five dimensions that we thought would be most relevant to a study of the use of surveillance technology versus physical restraints. These five subscales were Care Relationship (seven items, alpha of 0.81), Positive Affect (six items, alpha of 0.86), Negative Affect (three items, alpha of 0.77), Restless, Tense Behavior (three items, alpha of 0.76) and Social Relations (six items, alpha of 0.80). Each scale has a four-point scale, with a higher score indicating a more desirable outcome.

Procedure

Before the first measurement, each participating psychogeriatric nursing home determined the number of residents having one or more forms of surveillance technology and/or one or more forms of physical restraints. Changes in these data were assessed before the start of the second and third measurements. Residents who were assigned surveillance technology measures or physical restraints between measurements were added to the study. Residents, for whom the use of surveillance technology and/or physical restraints was discontinued, for whatever reason, were excluded from further measurements.
Research assistants visited the participating nursing homes for each measurement. The questionnaire that comprised the scales described previously was web-based, enabling the research assistants to access it via computers, available in each nursing-home ward for each measurement. The assistants all followed a computer training session, given by the first and fifth authors, in order to be able to do this correctly. The questionnaire was answered by the RN or CNA who best knew the resident in question. The research assistant asked each question orally and then entered the answers on the computer. All the completed questionnaires were saved electronically and were subsequently transferred to SPSS and MLwiN.

Data analysis

T-tests and chi-squared tests were used to compare the characteristics of residents subject to surveillance technology versus physical restraints. We carried out longitudinal multilevel regression analyses of the QUALIDEM data to assess the differences in quality of life between the two resident groups in the three measurements. The levels in the multilevel analyses were institution type, ward and individual resident. Univariate and multivariate regression models were computed. Resident characteristics were added in the multivariate models to adjust for potential confounding. The statistical computer programs used were SPSS version 15.0 and MLwiN.

RESULTS

Resident characteristics

The resident characteristics in the first measurement are presented in Table 2. No significant differences in age and sex between residents with surveillance technology and residents with physical restraints were found. Also, there were no differences in behavioral problems, as indicated by comparable scores on the NPI and RAI subscales of Mood and Behavior.

[TABLE 2]

However, on average, residents with surveillance technology were in a less advanced stage of dementia than residents with physical restraints (as indicated by a lower Global Deterioration Scale score) and they had significantly more independence in ADL (as shown by a higher score on the Barthel Index).

Highly ADL dependent residents

The binary Barthel results underline the huge differences in ADL dependency between the two study groups (Table 2). Surveillance technology was predominantly used in residents with medium ADL dependency (Barthel Index > 5) while physical restraints were predominantly used in residents with high ADL dependency (Barthel Index ≤ 5). Because of this difference between the two groups we restricted the regression analyses to the subgroup of highly dependent residents (n = 53).

Differences in quality of life

Table 3 shows the longitudinal quality of life of highly dependent residents with physical restraints (n = 18) and with surveillance technology (n = 35), displayed using the mean subscale scores for QUALIDEM. A global overview of the five QUALIDEM subscale scores in the first measurement yields the following results. Residents in both study groups sometimes have a satisfying care relationship with their professional caregivers and sometimes experience positive affect. In addition, residents in both study groups seldom show negative affect or restless, tense behavior. However, they seldom have good social relationships.

[TABLE 3]

Table 4 shows the results of both unadjusted and adjusted longitudinal multilevel regression analyses performed on these QUALIDEM scores. The univariate regression results show that residents with surveillance technology had significantly more positive affect than residents with physical restraints. However, this difference proved to be no longer significant after adjustment for the confounders of age and sex. There was no significant effect for the other four assessed dimensions of quality of life in the unadjusted models.

[TABLE 4]

DISCUSSION

This study explored mood, behavioral and societal aspects of the quality of life of residents with surveillance technology, compared with residents with physical restraints. Initial data analyses showed that residents for whom surveillance technology was used were in a less advanced stage of dementia and, above all, had more independence in ADL. The differences in ADL dependency were so large that there were practically no residents with good ADL capabilities under physical restraints. We therefore decided to restrict the comparison of the two study groups to the subgroup of highly dependent residents.

In this subgroup, residents subjected to surveillance technology had significantly more positive affect than residents with physical restraints. However, the difference in positive affect in the subgroup with a large ADL dependency disappeared after adjustment for confounding. Consequently, the differences in positive affect are not related to the use of surveillance technology versus physical restraints, but to the fact that residents in the two groups differed in terms of age and sex.

Our finding seems inconsistent with the results of the study by Lauriks et al. (2008), which indicated a positive effect of surveillance technology on certain aspects of the quality of life. However, surveillance technology was not used as an alternative to physical restraints in the study by Lauriks et al. Rather, it was meant to increase safety and freedom of movement for all residents. Consequently, the results showed that the introduction of surveillance technology did not have a significant effect on the use of physical restraints. On units with surveillance technology, only two (of the 30) residents had physical restraints, whereas on units without surveillance technology, there were three (of the 24) residents with physical restraints.

The expectation that surveillance technology would have a positive effect on the quality of life of people with dementia was based on the supposition that surveillance technology would give them greater freedom of movement. A possible explanation for the non-significant results of the present study could be that this supposition is not valid for people with high ADL dependency. Their freedom of movement may already be reduced to such a degree that physical restraints do not significantly restrict it further. Conversely, surveillance technology may only benefit those who can already move without the help of others.

Unfortunately, we could not test this hypothesis in our study as there were only four residents in the study with medium ADL dependency who were under physical restraints. The prevalence of physical restraints in the institutions participating in this

study, performed in 2010, was far lower than the Dutch average in nursing homes in 2005: 5.4% as opposed to 56% (Hamers & Huizing, 2005). This suggests that the use of physical restraints in this subgroup has fallen in recent years.
However, there could also be a relevant methodological issue. There was no measurement before residents were put under surveillance technology or physical restraints to establish potential baseline differences between these two groups. Therefore, it can be theorized that the ADL dependency in residents with physical restraints was actually caused by the use of these measures, violating a condition for the presence of confounding (in this case stratifying according to ADL dependency). Therefore, further research into surveillance technology as an alternative to physical restraints would need a more robust design.
Another methodological explanation for the lack of significant results may be the choice of quality of life as a dependent variable. Quality of life is a very broad concept, influenced by many factors such as awareness of memory function (Trigg et al., 2011) and neuropsychiatric symptoms, cognition and psychotropic drug use (Wetzels et al., 2010). Although not a confounder in this study, neuropsychiatric symptoms seem to affect quality of life even more than environmental factors such as facility size or a homelike environment (Samus et al., 2005). It could be that the contribution of surveillance technology versus physical restraints is relatively small and therefore proved non-significant, especially in our relatively small and highly ADL-dependent sample. We therefore recommend including other measures, in particular fall incidents and theiroutcomes, in further research into the effects of surveillance technology compared with physical restraints.
Looking at the differences between residents with surveillance technology and those with physical restraints, it seems that these two measures are generally prescribed for different groups within the population of people with dementia. Moreover, the much larger number of residents with surveillance technology as opposed to those with physical restraints suggests that nursing home staff may be more ready to apply the former measure. Surveillance technology may thus be often used as a kind of intermediate measure before physical restraints become necessary. Qualitative research seems to support this (Zwijsen et al., 2012).

In conclusion, the quality of life of highly dependent nursing-home residents with dementia seems to be unrelated to the use of surveillance technology versus physical restraints. Although surveillance technology may give residents with dementia more freedom of movement, it does not automatically provide them with a better quality of life. This may be a small comfort to those residents whose complex care needs and/or severe behavior issues leave professional caregivers no other options than using physical restraints.

Conflict of interest

None declared.

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TABLES

Table 1 Number of surveillance technology devices and physical restraints devices in the two study groups in the first measurement

	Residents with surveillance technology ($N = 170$)		Residents with physical restraints[a] ($N = 22$)	
	N	%	*N*	%
Surveillance technology				
Cameras	0	0	0	0
Acoustic monitoring systems	35	12	1	14
Chips worn in clothing	49	17	1	14
GPS	8	3	0	0
Inactivity sensors	13	5	0	0
Movement sensors	148	52	5	72
Door sensors	25	9	0	0
Pressure sensors in bed	6	2	0	0
Total number of devices	284	100	7	100
Physical restraints				
Fixation	0	0	12	52
Restrictive chair	0	0	11	48
Total number of physical restraints	0	0	23	100

[a]Seven residents with physical restraints were under surveillance technology as well. We counted these in the physical restraint group as we considered their physical restraints to have most influence on quality of life.

Table 2 Resident characteristics in the first measurement ($N = 192$)

	Residents with physical restraints ($N = 22$)	Residents with surveillance technology ($N = 170$)	
	M (SD) [a]	M (SD) [a]	
Age	83 (9.2)	83 (7.0)	$F = 1.67$
Sex			$\chi^2 = 3.40$
Male	4 (18.2%)	65 (38.2%)	
Female	18 (81.8%)	105 (61.8%)	
GDS	6 (0.6)	5 (1.1)	$t = -5.80$***
Barthel (continuous)	2.5 (2.8)	9.7 (5.1)	$t = 10.19$***
Barthel (dichotomized)			$\chi^2 = 46.20$***
≤5	18 (81.8%)	35 (20.6%)	
>5	4 (18.2%)	135 (79.4%)	
NPI	11.9 (6.4)	11.9 (7.4)	$t = 0.02$
RAI mood	7.7 (4.9)	8.9 (6.4)	$t = 0.87$
RAI behavior	7.0 (4.5)	5.6 (4.0)	$t = -1.39$

[a]Unless indicated otherwise.

GDS, Global Deterioration Scale; NPI, Neuropsychiatric Inventory-Questionnaire; RAI, Resident Assessment Instrument.

***$p < 0.001$.

Table 3 Quality of life mean scores for residents with low ADL with physical restraints and with surveillance technology in the three measurements ($N = 53$)

QUALIDEM	Residents with physical restraints (N = 18)						Residents with surveillance technology (N = 35)					
	T1		T2		T3		T1		T2		T3	
	M	95% CI	M	95% CI	M	95% CI	M	95% CI	M	95% CI	M	95% CI
Care relationship	2.0	1.6–2.4	2.2	0.5–2.5	2.0	1.8–2.3.	2.1	1.9–2.4	2.2	2.1–2.3	2.1	1.9–2.2
Positive affect	1.9	1.5–2.3	1.9	1.6–2.4	1.7	1.4–2.1	2.1	1.9–2.3	2.3	2.1–2.5	2.4	2.2–2.6
Negative affect	1.9	1.4–2.3	1.9	1.3–2.4	1.8	1.1–2.4	1.9	1.6–2.2	2.1	1.7–2.4	2.4	2.2–2.7
Restless, tense behavior	1.7	1.3–2.2	1.3	0.8–1.8	1.3	0.8–1.7	1.7	1.4–2.0	1.6	1.2–2.0	1.8	1.5–2.2
Social relations	0.7	0.5–1.0	0.9	0.6–1.1	1.0	0.8–1.3	1.0	0.8–1.2	1.1	0.9–1.3	1.1	0.8–1.3

QUALIDEM ranges: 0–3 (0 = never, 1 = seldom, 2 = sometimes, 3 = often). A higher score signifies a more desirable outcome.

Table 4 Longitudinal univariate and multivariate regression results for the quality of life of residents with low ADL with physical restraints and with surveillance technology in the three measurements ($N = 53$)

QUALIDEM	Residents with surveillance technology ($N = 35$) versus residents with physical restraints ($N = 18$)					
	B unadjusted	95% CI	*B* adjusted[a]	95% CI	*B* adjusted[b]	95% CI
Care relationship	0.46	−1.43–2.35	0.62	−1.39–2.61	0.63	−1.41–2.68
Positive affect	1.71*	0.10–3.33	1.28	−0.44–3.01	1.29	−0.48–3.06
Negative affect	−0.46	−1.50–0.58	−0.69	−1.83–0.44	−0.55	−1.70–0.60
Restless, tense behavior	−0.18	−1.22–0.88	0.01	−1.14–1.15	−0.01	−1.26–1.09
Social relations	1.03	−0.22–2.29	1.23	−0.14–2.60	1.09	−0.30–2.48

QUALIDEM ranges: 0–3 (0 = never, 1 = seldom, 2 = sometimes, 3 = often). A higher score signifies a more desirable outcome.
[a]Adjusted for age and sex.
[b]Adjusted for age, sex and Global Deterioration Scale stage.
*$p < 0.05$.