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Original Study

The Association Between Pain Perception and Care Dependency in Older Nursing Home Residents: A Prospective Cohort Study

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A B S T R A C T

Objectives: Maintenance of independence is a challenge for nursing home residents whose pain is often substantial. The objective of this study was to explore the relationship between pain perception and care dependency in a population of Dutch nursing home residents.
Design: Prospective cohort study.
Setting and participants: Dutch nursing home residents aged 65 or older, excluding residents with a severe cognitive impairment.
Methods: The Numeric Rating Scale (NRS) was used to rate pain perception from 0 to 10 in half-point increments and the Care Dependency Scale (CDS) to measure care dependency, with scores ranging from 15 (completely care dependent) to 75 (fully independent). Both measurements were repeated after a 2-month follow-up. Multiple linear regression analysis was used to adjust for potential confounders. Missing data were dealt with by performing tenfold multiple imputation.
Results: A total of 1256 residents (65% women, mean age 83 years) were included. At baseline, the median NRS pain score was 3.0 (interquartile range 0.0–6.0) and the mean CDS score was 55.9 (SD 11.5). Cross-sectionally, for 1-point increase in pain score, care dependency increased 0.65 points [95% confidence interval (CI) 0.46–0.83]. More pain at baseline was associated with slightly lower care dependency after 2 months (beta 0.20, 95% CI 0.01–0.39). Compared with residents whose pain decreased over 2 months, residents with stable pain or increased pain had a 2.27-point (95% CI 0.83–3.70) and 2.39-point (95% CI 0.87–3.90) greater increase in care dependency, respectively.
Conclusions and implications: Pain perception and care dependency are associated in a population of older nursing home residents, and stable or increased pain is associated with increased care dependency progression. The findings of this study emphasize that pain and care dependency should not be assessed nor treated independently.

Worldwide, the proportion of older people is rising.[1] Older people most often prioritize maintenance of independence as treatment goal.[2] However, a longer life is accompanied by an increased risk of institutionalization.[3] In nursing homes, care dependency in activities of daily living (ADL) negatively affects the residents' quality of life,[4] as well as health costs and workload for the nursing home staff.[5–7] For these reasons, care in nursing homes and for older people in general should focus on maintenance of independence, and studies in an older population should consider care dependency as an outcome measure.

Identifying risk factors for care dependency in nursing home residents is important for targeted interventions. Pain is a potential risk factor with a large-scale impact on mood and well-being, and interference of pain with daily activities decreases the health-related quality of life in nursing home residents.[8–10] Approximately half of the European nursing home residents suffer from pain, and their discomfort is often insufficiently managed.[11] Although theoretically higher pain intensity could impede physical and social activities, leading to care dependency, evidence for such a link is inconsistent. Whereas Tabali et al.[12] did not find an association between pain and care dependency, pain and impairments in ADL have been correlated.[13–15]

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A better understanding of the relationship between pain and care dependency could improve interventions to prevent and manage care dependency. It was hypothesized that there is an association between more pain and higher care dependency cross-sectionally and that more baseline pain is associated with higher care dependency at follow-up. The primary objective of this study is to explore the association between pain perception and care dependency cross-sectionally in older residents in Dutch nursing homes. The secondary objective is to examine the effect of pain at baseline on care dependency at follow-up and to explore the association between a change in pain and a change in care dependency over time.

Methods

Study Design, Setting, and Participants

This study is an ongoing prospective cohort study of Dutch nursing home residents. Data are collected for both educational and research purposes by first-year medical students from the Leiden University Medical Center in the Netherlands.[16] Beforehand, they are trained in adequate data collection processes to ensure data quality. Annually, the assessors are split into 2 shifts and assigned to a single ward in a participating nursing home to do a 2-week nursing internship. Besides care activities, each assessor is carefully instructed to include the most recently admitted resident of this ward for baseline data collection in a systematic manner. Assessors return to the nursing home after 2 to 3 months for follow-up data collection of the same resident. Data for the current study were collected between 2013 and 2019 in 233 nursing homes. The STROBE guidelines for observational studies was followed,[17] and the relevant institutional ethics committee gave permission for the study.

Inclusion and Exclusion Criteria

The study was restricted to residents aged 65 or older. Due to the nature of data collection it is possible that residents are included twice. Therefore, double cases were excluded after identification based on date of birth, sex, admission date, and year of data collection. Also, subjects with a missing baseline pain score or less than 8 of 15 items available on care dependency at baseline were excluded. Furthermore, cognitive performance was assessed using the Cognitive Performance Scale (CPS), which assigns nursing home residents to 7 categories ranging from intact cognitive performance to very severe impairment. Residents with a severe or very severe cognitive impairment were excluded, being unable to reliably self-report pain.[18]

Pain Perception

Residents' current pain perception was collected by interview, using the Numeric Rating Scale (NRS). The scale has been proven valid in older persons.[19] Pain was rated from 0 (no pain) to 10 (worst pain imaginable) in half-point increments. The minimal clinically important difference in pain score is 1 point.[20] If the assessor thought that the resident was not able to reliably report their pain due to cognitive impairment, the NRS was not filled in.

Care Dependency

The Care Dependency Scale (CDS) was scored based on the assessors' observations and in consultation with the regular nursing staff. The CDS is considered valid and reliable.[21–24] Care dependency is evaluated in 15 categories by means of a 5-point Likert scale: food consumption, incontinence, body posture, mobility, circadian rhythm, dressing, maintenance of body temperature, hygiene, avoidance of danger, communication, social contact, sense of values and standards, daily activities, recreational activities, and learning ability. The lowest score is 15, indicating the resident is completely care dependent, and the highest score is 75, indicating the resident is fully independent. Thus, the lower the CDS score, the higher the care dependency.

Confounding Factors

Potential confounding factors were determined a priori using expert knowledge and existing literature.[25–28] A variable was included as a confounder if it matched the following 3 criteria: (1) it is a risk factor for care dependency; (2) it is associated with pain; and (3) it is not an effect of pain.[29] Potential confounding factors were measured at baseline. Data on the residents' date of birth, sex, admission date, patient history, chronic diseases, and medication were extracted from the electronic health records. Fall history was both verified by the residents themselves and extracted from their records. Cognitive performance was assessed using the CPS, which is minimally stressful for the residents and corresponds closely with the Mini-Mental State Examination and the Test for Severe Impairment.[30] Age and time since admission were treated as continuous variables, cognitive performance as a categorical variable, and all other potential confounders were collected as dichotomous variables. Confounding was adjusted for in a stepwise fashion. The crude model 1 includes no confounders. Model 2 adjusts for age and sex. Model 3 adds cerebrovascular accident, myocardial infarction, and malignancy in the patient history, as well as chronic obstructive pulmonary disease, diabetes mellitus, rheumatoid arthritis, falls in the past 3 months, time since admission to the ward, and cognitive performance. Depression medication and benzodiazepines were added in a separate model as a sensitivity analysis. The diagnoses depression and anxiety were not measured, and therefore medication was used as a proxy. Depression and anxiety are potential confounders but may also be an effect of pain and thus part of the mechanisms through which pain causes care dependency.[31]

Data Analysis

Normally distributed variables are presented as mean values with standard deviations, non-normally distributed variables as median values with the interquartile range, and categorical variables as percentages. Baseline characteristics of the study population were stratified by absence (NRS 0–3.5) and presence (NRS 4–10) of substantial pain. Following the CDS guideline, the maximum of 7 missing items were replaced by the mean value of the remaining items.[32] Missing data for confounding variables were dealt with by performing tenfold multiple imputation to prevent selection bias.[33,34] All measured resident characteristics potentially predictive for the missing confounding variables were used in the imputation model, including pain, care dependency, death, and other resident characteristics at follow-up. Missing values for pain and care dependency were not imputed in the main analysis.

To assess the association between pain perception and care dependency, multiple linear regression analyses were performed. First, the cross-sectional association between the NRS score and the CDS score at baseline was analyzed. Next, the association between the baseline NRS score and the CDS score at follow-up was studied, adjusting for the baseline CDS score. Finally, the association between the change on the NRS and on the CDS was studied, subtracting the baseline scores from the follow-up scores. In the latter 2 analyses, residents were excluded if the pain score or CDS score was not available at follow-up. To visualize possible disproportionality in effect, the change in pain score was divided into 3 categories: decrease in pain (change < 0), stable pain (change $= 0$) or increase in pain (change > 0). In all other analyses the NRS and CDS scores were kept continuous. The same step-by-step method of adjusting for

confounding factors was used in all analyses. The regression coefficients were pooled over the 10 imputation datasets using Rubin's rules.[35] Assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity were checked and met in all performed linear regression analyses.[36,37]

Further sensitivity analyses were performed. To assess the modification effect of cognitive function, the cross-sectional association between pain and care dependency was stratified by 4 categories, ranging from intact cognitive function to moderate severe cognitive impairment. In addition, the effect of attrition and missing baseline data were assessed by repeating the 3 main analyses while imputing both missing pain and care dependency data, except when residents died, were discharged, or when no follow-up visit was conducted. All analyses were performed in IBM SPSS Statistics for Windows version 25 (IBM Corp., Armonk, NY).

Results

In total, data from 1988 residents were collected. Ten percent of the residents were excluded for being younger than 65 years, 13% for having a severe or very severe cognitive impairment based on the CPS, 14% for missing data on pain, and 1 resident for missing data on care dependency. A total of 1256 residents fit the study criteria for the main cross-sectional analysis. From these residents, 28% were lost to follow-up and for 13% no follow-up visit was conducted because the study had ended. Another 4% moved or were discharged, and 2% died. From the remaining 673 residents, 10% were excluded for missing data on care dependency at follow-up and 11% for missing data on pain at follow-up (flowchart shown in Figure 1). Baseline characteristics for residents with and without substantial pain are shown in Table 1. The variables in Table 1 had 10% missing values on average. The median NRS pain score was 3.0 (interquartile range 0.0–6.0) and the mean care dependency score was 55.9 points (SD 11.5) in the total population. The following differences between the group with and without substantial pain are notable. The substantial pain group was more frequently female, had lived in the nursing home for a shorter period, and had fallen more often. Also, their cognitive function was more often intact, they suffered from rheumatoid arthritis more frequently, and used more pain medication. The mean follow-up time was 2.3 months (SD 0.5). Pain and care dependency increased (CDS score decreased) by 0.2 and 1.7 points respectively for residents with a follow-up measurement.

Table 2 shows the cross-sectional association between baseline pain and care dependency. It also shows the association between baseline pain and care dependency after 2 months. Cross-sectionally,

Table 1
Resident Characteristics at Baseline Stratified by Pain Perception

	Total Population (n = 1256)	NRS 0–3.5 (n = 674)	NRS 4–10 (n = 582)
Age (mean, SD)	83.2 (7.4)	83.3 (6.9)	83.0 (7.9)
Sex (% female)	65.4	61.3	70.3
No. wk since admission (median, IQR)	5.0 (1.4–17.4)	6.0 (1.9–19.7)	4.1 (1.3–15.4)
Fallen in past 3 mo (%)	39.1	28.6	51.0
Cognitive function (%)			
Intact	34.8	29.8	40.5
Borderline intact	23.1	23.3	22.9
Mild impairment	19.7	21.1	18.0
Moderate-moderate severe impairment	22.5	25.8	18.5
Comorbidities (%)			
Diabetes mellitus	20.2	19.7	20.9
Rheumatoid arthritis	8.6	5.6	12.2
COPD	14.2	14.0	14.5
Patient history (%)			
Myocardial infarction	11.4	12.1	10.7
CVA	23.9	23.5	24.2
Cancer	21.9	21.9	21.9
Pain medication (%)			
WHO 1 pain medication	67.1	54.7	81.2
WHO 2 pain medication	12.7	6.6	20.0
WHO 3 pain medication	14.9	6.8	24.4

COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; IQR, interquartile range; WHO, World Health Organization.

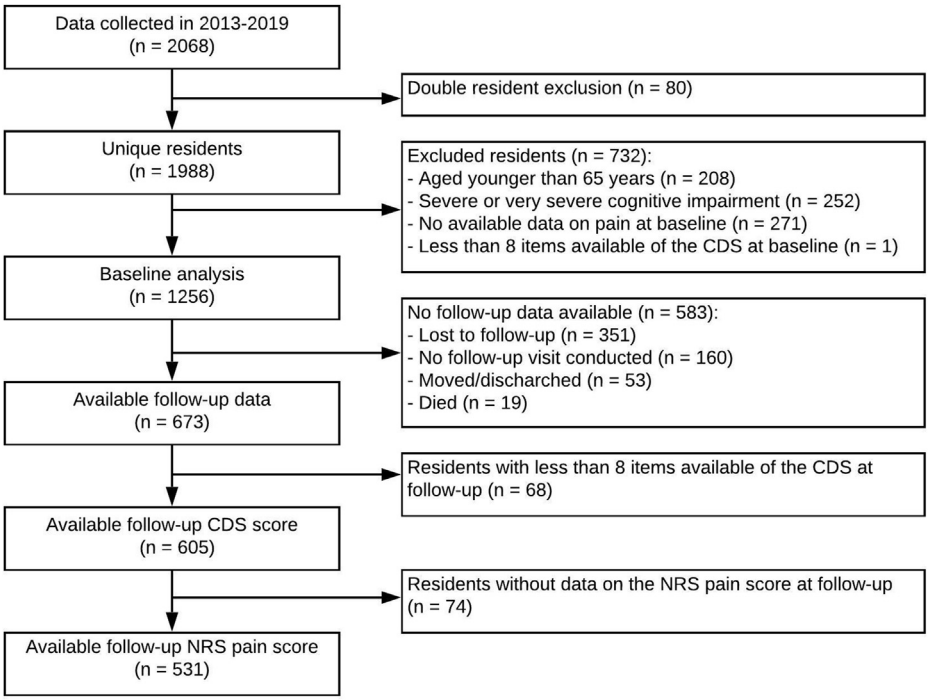

Fig. 1. Flowchart of the study population.

Table 2
Association of the Baseline NRS Pain Score With the CDS Score at Baseline and at a 2-month Follow-up

Regression Coefficient (95% Confidence Interval)								
Adjust. model*	Baseline CDS (n = 1256)				Follow-up CDS (n = 605)†			
	B	Lower Bound	Upper Bound	*P* Value	B	Lower Bound	Upper Bound	*P* Value
1	−0.42	−0.64	−0.21	<.001	0.20	0.02	0.38	.028
2	−0.47	−0.69	−0.26	<.001	0.21	0.03	0.39	.022
3	−0.65	−0.83	−0.46	<.001	0.20	0.01	0.39	.043

*Model 1: crude association. Model 2: adjustment for age and sex. Model 3: adjustment for age, sex, myocardial infarction, cerebrovascular accident, diabetes mellitus, malignancy, chronic obstructive pulmonary disease, rheumatoid arthritis, fall history, duration of admission to ward and cognitive performance.
†The baseline CDS score was added to adjustment models 1–3.

for every point increase in pain, care dependency increased with 0.65 points [95% confidence interval (CI) 0.46–0.83], after adjustment for confounding factors. However, more baseline pain was associated with slightly lower care dependency (higher CDS score) at follow-up, with an adjusted regression coefficient of 0.20 (95% CI 0.01–0.39). The crude model and adjustment for solely age and sex showed comparable effects in both analyses.

Figure 2 is a graphic representation of the crude relationship between the change in pain and care dependency. In residents with decreased pain (n = 147), care dependency remained stable, while in residents with stable pain (n = 208) or increased pain (n = 176), care dependency increased (CDS score decreased) with 2 points over 2 months. Table 3 shows that residents with stable or increased pain had respectively a 2.27-point (95% CI 0.83–3.70) and 2.39-point (95% CI 0.87–3.90) greater increase in care dependency than residents whose pain decreased over 2 months, after adjustment for confounders.

Sensitivity analyses showed robustness of the findings (see Appendices 1 to 3). Adding depression medication and benzodiazepines to adjustment model 3 had a negligible effect on the results in all analyses (data not shown).

Discussion

The relationship between pain perception and care dependency in older nursing home residents was explored in this study. Cross-sectionally, more pain and higher care dependency were associated. However, more pain at baseline was not associated with higher care dependency after 2 months. Nevertheless, both stable pain and an increase in pain were associated with increased care dependency progression compared with residents who experienced a decrease in pain.

These results support the presence of a relationship between pain and care dependency. Although the cross-sectional increase in care dependency of 0.65 points for every point increase in pain score may seem small compared with the possible CDS range of 60 points, the interquartile range of the NRS pain score is wide in this population (0.0–6.0 points). These 6 points can be translated into a difference of almost 4 points on the CDS. By comparison, the CDS decreases only 1 point during a urinary tract infection.[38] Whereas the minimal clinically important difference of the CDS sum score has not been defined in literature, the 15 items reflect the fundamental needs in nursing care,[39] and thus a change in any of those items is meaningful. Not only is every small win in the CDS sum score associated with decreased mortality and improved quality of life,[27,40] indirect wins like decreasing staff distress and health costs are also relevant issues in an ageing society.[6] Longitudinally, care dependency increased with 2 points for residents with stable or increased pain, whereas care dependency was stable in residents with decreased pain. Considering single items of the CDS on an individual level, these 2 points could make the difference between losing or maintaining self-esteem in performing daily activities or the ability to eat, for example. Because the residents with stable and increased pain made up as much as 70% of the studied population, adequate pain treatment may have a wide-scale impact on care dependency. Randomized trials investigating the effect of pain management on care dependency are therefore recommended.

As more pain at baseline was only associated with higher care dependency cross-sectionally and not with higher care dependency at follow-up, the results cannot discriminate between pain affecting care dependency or reverse causation. For example, pain could lead to care dependency due to impaired range of motion and decreased willingness to move.[41] Also, pain is strongly associated with depression in nursing homes,[42,43] which in turn is a risk factor for a deterioration in ADL performance and thus more individual care demands.[27,44] The other way around, care dependency may lead to pain through conditions like muscle contractures or pressure ulcers, which are the result of decreased activity and mobility.[45,46] For these reasons, the potential reciprocal relationship between pain and care dependency should be further explored in future studies.

In contrast to the hypothesis, more pain at baseline was associated with improved independence after 2 months, although the effect size was small. A possible explanation is that residents who are admitted with substantial pain experience a decrease in pain during follow-up

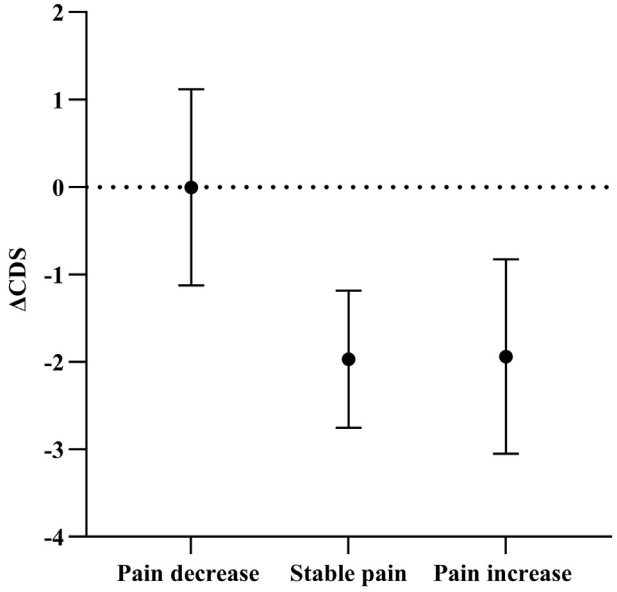

Fig. 2. Change on the CDS for residents with decreased (n = 147), stable (n = 208), or increased (n = 176) pain score on the NRS over 2 months (mean values with 95% CIs). Care dependency was stable in residents whose pain decreased, whereas care dependency increased in residents with a stable or increased pain. ΔCDS = baseline CDS score subtracted from the CDS score after 2 months (a negative change score indicates an increase in care dependency).

Table 3
Relative Change on the CDS in Residents With Stable or Increased Pain Compared With Residents Who Experienced a Decrease in Pain Over 2 Months (n = 531)

Regression Coefficient (95% Confidence Interval)					
Adjust. model*	NRS pain	B	Lower Bound	Upper Bound	*P* Value
1	Decrease	0†			
	Stable	−1.97	−3.37	−0.56	.006
	Increase	−1.93	−3.39	−0.47	.009
2	Decrease	0†			
	Stable	−2.06	−3.47	−0.65	.004
	Increase	−2.07	−3.54	−0.60	.006
3	Decrease	0†			
	Stable	−2.27	−3.70	−0.83	.002
	Increase	−2.39	−3.90	−0.87	.002

*Model 1: crude association. Model 2: adjustment for age and sex. Model 3: adjustment for age, sex, myocardial infarction, cerebrovascular accident, diabetes mellitus, malignancy, chronic obstructive pulmonary disease, rheumatoid arthritis, fall history, duration of admission to ward and cognitive performance.
†The group with a decrease in pain was set as reference.

as a result of pain treatment and regression to the mean, especially residents admitted to a care facility for rehabilitation purposes. The relief of pain then leads to improved independence at follow-up.[47] This explanation is supported by the statistically significant difference in care dependency progression between the residents who experienced a decrease in pain and those with stable pain. The reason for admission and projected length of stay were not assessed in the current study. Therefore, the question whether observed findings are due to naturalistic changes in pain and care dependency or to successful treatment of pain causing conditions remains unanswered.

The results are in line with previous studies that reported a correlation between pain and impairments in ADL in a population of nursing home residents.[13–15,48] However, in the cross-sectional study by Tabali et al.[12] no association was found between the CDS score and pain perception. Several reasons may explain this difference in results. Despite a similar study population, power was smaller in their study with only 120 residents. Also, pain was measured with yes/no questions, and the CDS score was divided into 3 categories.

The current study has several strengths and limitations. The sample size and thus the precision of the study is large compared to the existing literature on care dependency in nursing homes. Potential confounders were carefully evaluated a priori based on literature and expert knowledge, and valid scales were used.[19,21–24,30] Selection bias should be considered as quite a few residents were lost to follow-up or had missing pain or care dependency data. However, the sensitivity analysis in which the missing values of pain and care dependency were imputed did not change the conclusions. The study design could have been improved by assessing the reason for admission to the nursing home and with additional follow-up measurements for pain and care dependency. Repeated measurements with a shorter interval for longer than 2 months could provide insight in the short-term and long-term effect of pain on care dependency. Another limitation is the exclusion of residents with a severe or very severe cognitive impairment. Pain as a risk factor may be especially important for this patient group because their discomfort is often underdiagnosed and undertreated.[49] Nevertheless, the current study is a good representation of large nursing home populations without severe cognitive impairment.

Conclusions and Implications

Pain perception and care dependency are associated in a population of older nursing home residents, and stable or increased pain is associated with increased care dependency progression. The findings of this study support a more holistic approach and emphasize that pain and care dependency should not be assessed nor treated independently. A multidisciplinary geriatric assessment is crucial for nursing home residents and may lead to improvements in both pain perception and independence.

Data Sharing Statement

In principle, data are not available because of confidentiality issues; however, interested investigators can submit their research proposal with a request for data to the authors.

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Supplementary Data

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.jamda.2020.07.022.

References

1. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: The challenges ahead. Lancet 2009;374:1196–1208.
2. Stegmann ME, Festen S, Brandenbarg D, et al. Using the Outcome Prioritization Tool (OPT) to assess the preferences of older patients in clinical decision-making: A review. Maturitas 2019;128:49–52.
3. Batljan I, Lagergren M. Future demand for formal long-term care in Sweden. Eur J Ageing 2005;2:216–224.
4. Ballard C, O'Brien J, James I, et al. Quality of life for people with dementia living in residential and nursing home care: The impact of performance on activities of daily living, behavioral and psychological symptoms, language skills, and psychotropic drugs. Int Psychoger 2001;13:93–106.
5. Meijer A, Van Campen C, Kerkstra A. A comparative study of the financing, provision and quality of care in nursing homes. The approach of four European countries: Belgium, Denmark, Germany and The Netherlands. J Adv Nurs 2000; 32:554–561.
6. Cylus J, Figueras J, Normand C. Will Population Ageing Spell the End of the Welfare State? A Review of Evidence and Policy Options. Copenhagen: European Observatory on Health Systems and Policies; 2019.
7. Aasmul I, Husebo BS, Flo E. Staff distress improves by treating pain in nursing home patients with dementia: Results From a cluster-randomized controlled trial. J Pain Symptom Manage 2016;52:795–805.
8. Lapane KL, Quilliam BJ, Chow W, Kim M. The association between pain and measures of well-being among nursing home residents. J Am Med Dir Assoc 2012;13:344–349.
9. Torvik K, Kaasa S, Kirkevold O, Rustøen T. Pain and quality of life among residents of Norwegian nursing homes. Pain Manag Nurs 2010;11:35–44.
10. Brandauer A, Berger S, Freywald N, et al. Quality of life in nursing home residents with pain: Pain interference, depression and multiple pain-related diseases as important determinants. Qual Life Res 2020;29:91–97.
11. Lukas A, Mayer B, Fialova D, et al. Pain characteristics and pain control in European nursing homes: cross-sectional and longitudinal results from the Services and Health for Elderly in Long TERm care (SHELTER) study. J Am Med Dir Assoc 2013;14:421–428.
12. Tabali M, Ostermann T, Jeschke E, et al. Does the care dependency of nursing home residents influence their health-related quality of life? A cross-sectional study. Heal Qual Life Outcomes 2013;11:41.
13. Achterberg WP, Gambassi G, Finne-Soveri H, et al. Pain in European long-term care facilities: Cross-national study in Finland, Italy and The Netherlands. Pain 2010;148:70–74.
14. Tse MMY, Wan VTC, Vong SKS. Health-related profile and quality of life among nursing home residents: does pain matter? Pain Manag Nurs 2013;14:e173–e184.
15. Won A, Lapane K, Gambassi G, et al. Correlates and management of nonmalignant pain in the nursing home. SAGE Study Group. Systematic Assessment of Geriatric drug use via Epidemiology. J Am Geriatr Soc 1999;47:936–942.
16. Ommering BWC, van Blankenstein FM, Wijnen-Meijer M, et al. Fostering the physician–scientist workforce: A prospective cohort study to investigate the effect of undergraduate medical students' motivation for research on actual research involvement. BMJ Open 2019;9:e028034.
17. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61:344–349.
18. Corbett A, Husebo B, Malcangio M, et al. Assessment and treatment of pain in people with dementia. Nat Rev Neurol 2012;8:264–274.
19. Kim YS, Park JM, Moon YS, Han SH. Assessment of pain in the elderly: A literature review. Natl Med J India 2017;30:203–207.

20. Salaffi F, Stancati A, Silvestri CA, et al. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. Eur J Pain 2004;8:283–291.
21. Lohrmann C, Dijkstra A, Dassen T. Care dependency: Testing the German version of the Care Dependency Scale in nursing homes and on geriatric wards. Scand J Caring Sci 2003;17:51–56.
22. Dijkstra A, Tiesinga LJ, Plantinga L, et al. Diagnostic accuracy of the care dependency scale. J Adv Nurs 2005;50:410–416.
23. Dijkstra A, Tiesinga LJ, Goossen WT, Dassen TW. Further psychometric testing of the Dutch Care Dependency Scale on two different patient groups. Int J Nurs Pr 2002;8:305–314.
24. Janssen DJ, Wouters EF, Schols JM, Spruit MA. Care dependency independently predicts two-year survival in outpatients with advanced chronic organ failure. J Am Med Dir Assoc 2013;14:194–198.
25. Hendriks SA, Smalbrugge M, Galindo-Garre F, et al. From admission to death: prevalence and course of pain, agitation, and shortness of breath, and treatment of these symptoms in nursing home residents with dementia. J Am Med Dir Assoc 2015;16:475–481.
26. Takai Y, Yamamoto-Mitani N, Okamoto Y, et al. Literature review of pain prevalence among older residents of nursing homes. Pain Manag Nurs 2010;11:209–223.
27. Caljouw MA, Cools HJ, Gussekloo J. Natural course of care dependency in residents of long-term care facilities: prospective follow-up study. BMC Geriatr 2014;14:67.
28. Moore DC, Keegan TJ, Dunleavy L, Froggatt K. Factors associated with length of stay in care homes: a systematic review of international literature. Syst Rev 2019;8:56.
29. Jager KJ, Zoccali C, Macleod A, Dekker FW. Confounding: what it is and how to deal with it. Kidney Int 2008;73:256–260.
30. Morris JN, Fries BE, Mehr DR, et al. MDS Cognitive Performance Scale. J Gerontol 1994;49:M174–M182.
31. Geerlings SW, Twisk JWR, Beekman ATF, et al. Longitudinal relationship between pain and depression in older adults: Sex, age and physical disability. Soc Psychiatry Psychiatr Epidemiol 2002;37:23–30.
32. Dijkstra A, Smith J, White M. Measuring care dependency with the Care Dependency Scale (CDS) - A manual. Available at: https://www.umcg.nl/SiteCollectionDocuments/research/institutes/SHARE/assessment%20tools/CDS%20manual%20english.pdf. Accessed May 12, 2019.
33. de Goeij MC, van Diepen M, Jager KJ, et al. Multiple imputation: dealing with missing data. Nephrol Dial Transpl 2013;28:2415–2420.
34. Donders AR, van der Heijden GJ, Stijnen T, Moons KG. Review: A gentle introduction to imputation of missing values. J Clin Epidemiol 2006;59:1087–1091.
35. Rubin DB. Multiple Imputation for Nonresponse in Surveys. New York: John Wiley & Sons; 2004.
36. Marill KA. Advanced statistics: Linear regression, part I: Simple linear regression. Acad Emerg Med 2004;11:87–93.
37. Marill KA. Advanced statistics: Linear regression, part II: Multiple linear regression. Acad Emerg Med 2004;11:94–102.
38. Van Den Hout WB, Caljouw MAA, Putter H, et al. Cost-effectiveness of cranberry capsules to prevent urinary tract infection in long-term care facilities: Economic evaluation with a randomized controlled trial. J Am Geriatr Soc 2014;62:111–116.
39. Dijkstra A, Yönt GH, Korhan EA, et al. The care dependency scale for measuring basic human needs: an international comparison. J Adv Nurs 2012;68:2341–2348.
40. Dijkstra A, Hakverdioglu G, Muszalik M, et al. Health related quality of life and care dependency among elderly hospital patients: an international comparison. Tohoku J Exp Med 2015;235:193–200.
41. Kalinowski S, Drager D, Kuhnert R, et al. Pain, fear of falling, and functional performance among nursing home residents: A longitudinal study. West J Nurs Res 2019;41:191–216.
42. Smalbrugge M, Jongenelis LK, Pot AM, et al. Pain among nursing home patients in The Netherlands: prevalence, course, clinical correlates, recognition and analgesic treatment–an observational cohort study. BMC Geriatr 2007;7:3.
43. Erdal A, Flo E, Selbaek G, et al. Associations between pain and depression in nursing home patients at different stages of dementia. J Affect Disord 2017;218:8–14.
44. Bürge E, von Gunten A, Berchtold A. Factors favoring a degradation or an improvement in activities of daily living (ADL) performance among nursing home (NH) residents: a survival analysis. Arch Gerontol Geriatr 2013;56:250–257.
45. Wagner LM, Capezuti E, Brush BL, et al. Contractures in frail nursing home residents. Geriatr Nurs 2008;29:259–266.
46. Achterberg WP, Frijters DH, Ribbe MW. Prevalence of ulcers in Dutch nursing homes. Tijdschr Gerontol Geriatr 2008;39:115–121.
47. Lane NE, Stukel TA, Boyd CM, Wodchis WP. Long-term care residents' geriatric syndromes at admission and disablement over time: An observational cohort study. J Gerontol A Biol Sci Med Sci 2019;74:917–923.
48. Bjork S, Juthberg C, Lindkvist M, et al. Exploring the prevalence and variance of cognitive impairment, pain, neuropsychiatric symptoms and ADL dependency among persons living in nursing homes; a cross-sectional study. BMC Geriatr 2016;16:154.
49. Cravello L, Di Santo S, Varrassi G, et al. Chronic pain in the elderly with cognitive decline: A narrative review. Pain Ther 2019;8:53–65.