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ERRATUM

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# Erratum to: Association between pain, neuropsychiatric symptoms, and physical function in dementia: a systematic review and meta-analysis

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The original version of this article unfortunately contained some mistakes. The presentation of Table 2, Table 5 and Table 6 was incorrect. The corrected tables are given below.

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**Table 2** Measurements of pain, neuropsychiatric symptoms and physical function

| | Measurement of pain | | Measurement of neuropsychiatric symptoms | | Measurement of function | |
|---|---|---|---|---|---|---|
| First author | Rating scale | Method of detection | Rating scale | Method of detection | Rating scale | Method of detection |
| Ahn 2013[36] | MDS pain severity scale, combining pain frequency and pain intensity | Self-report, if not possible staff report based on proxy reports | MDS subscales; wandering-item, aggression behaviour scale (ABS), challenging behaviour profile (CBP) agitation subscale | Patient self-report, proxy and professional | MDS-ADL long form (7 items) | Staff observation |
| Bartels 2003[8] | No use of rating scale | Data collection instrument (3-month period), raters unknown | MDS for depression | Medical records | MDS (number of ADLs) | Medical records |
| Black 2006[39] | No use of rating scale | Medical records, preceding 6 months, interview surrogate and physician | No use of rating scales | Medical records, preceding 6 months, interview proxy and staff | No use of rating scale | Medical records, preceding 6 months, interview proxy and staff |
| Brummel-Smith 2002[40] | 1 out of 3 scales: faces or line scale, or word-based pain intensity scale | self-report, assessed by trained research assistants | No use of rating scales | Trained research assistants | No use of rating scale | Trained research assistants |
| Cipher 2004[4] | GMPI pain and suffering subscale | Part of neuropsychological evaluation by a licensed clinical geropsychologist | -GDS-15 "-26 dysfunctional behaviours with scores "1-7" | Part of neuropsychological evaluation by a licensed clinical geropsychologist | PRADLI | Part of neuropsychological evaluation by a licensed clinical geropsychologist |
| Cipher 2006[41] | GMPI | Part of neuropsychological evaluation by a licensed clinical geropsychologist and each instrument was administered after interviewing the resident, nursing staff and family members | GLDS, 19 categories with scores 1-7 | Part of neuropsychological evaluation by a licensed clinical geropsychologist and each instrument was administered after interviewing the resident, nursing staff and family members, Medical records, preceding 6 to max 26, Months | GLDS | Part of neuropsychological evaluation by a licensed clinical geropsychologist and each instrument was administered after interviewing the resident, nursing staff and family members |
| D'Astolfo 2006[44] | No use of rating scale | Medical records, preceding 6 to max 26 months | No use of rating scales | | No use of rating scale | Medical records Ambulatory status: independent, requires assistance, wheel chair (or bedridden n?=?1) |
| Gruber-Baldini 2005[45] | PGC-PIS, score ≥ 2 | Rating by supervisory staff member | CSDD<br>CMAI | Rating by supervisory staff member | MDS; activities of daily living scale, SMOI | Rating/observation by supervisory staff member |
| Kunik 2005[30] | PGC-PIS, item on level of pain in previous week, scores 1-6 | Interview with patient and proxy by trained interviewer/research assistant | CMAI<br>HAM-D<br>NPI (subdomains delusion/ hallucinations) | Interview with patient and proxy by trained interviewer/research assistant | - | - |
| Leonard 2006[50] | MDS pain burden using a 4-level composite score based on pain | - | MDS (Physical aggression: MDS item 'others were hit, shoved, scratched, sexually abused'; Depression: MDS score ≥3 on sum of 9 items, e.g. | - | - | - |

**Table 2** Measurements of pain, neuropsychiatric symptoms and physical function *(Continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| | frequency and intensity | | 'being sad', 'making negative statements', 'persistent anger with self or others', 'pained facial expressions'. (At least once in week before) | | | |
| Leong 2007[35] | PAINAD for non-communicative patients | Interviews with patient and staff member by professionals for communicative patients | Depression with GDS-15 or STAI<br>Anxiety with Cornell | Self-report or staff report | AAS | Not reported |
| Lin 2011[46] | PAINAD-Chinese version | Observation immediately following instances of routine care by principal investigator and research assistant | No use of rating scales | Medical records and observations by professional | No use of rating scale | Medical records and observation by professional |
| Morgan 2012[47] | PGC-PIS worst pain item | Not reported | CMAI aggression subscale<br>CMAI non-aggressive physical agitation subscale<br>HAM-D depression | Not reported | - | - |
| Norton 2010[42] | PPQ, intensity item, 10–14 day baseline | Primary CNA and data used from medical records | RMBPC-NH, selection of 3 need driven behaviours, BEHAVE-AD | Primary CNA and unit staff | PSMS | Nurses and trained research assistants |
| Shega 2005[48] | VDS, 1 item on presence and severity of pain 'right now' | Interviews with patients and caregivers by trained research assistant | GDS-15<br>CMAI | Interview patient and proxy | KATZ<br>IADL | Interview patient and proxy |
| Shega 2010[49] | VDS, 5 point, 'pain past 4 weeks' | Interviews with patient by trained research assistant | Mental Health screening questionnaire; 5-item and 6 point scale | Interview with patient by trained research assistant | OARS/IADL; 3 point scale | Interview patient by trained research assistant |
| Torvik 2010[48] | VRS, 4 point, 'pain right now' | Patient self-report | DQoL, 29-items on 5 domains: self-esteem, aesthetics, positive affect, negative affect, belonging | Not reported | Barthel | Self-report and medical records |
| Tosato 2012[3] | InterRAI LTCF | InterRAI LTCF questions and observation of behaviour, any type of pain or discomfort of the body in previous 3 days by trained (research) staff | InterRAI LTCF 5 behavioural symptoms, previous 3 days | Not reported | MDS ADL Hierarchy Scale | Data recorded by study physicians |
| Volicer 2009[37] | MDS-RAI pain frequency (item J2a) | Combination of physical examination, patient history, observation, consultation caregiver and medical records by staff | MDS Depression Rating Scale<br>MDS item J1e for delusions MDS item J1i for hallucinations | Combination of physical examination, patient history, observation, consultation caregiver and medical records by staff | - | - |
| Volicer 2011[51] | MDS | Combination of physical examination, patient history, observation, consultation | MDS items I1ee, E1a, E1d, E1f, E1b, E1i, E1l, E1m for depression | Combination of physical examination, patient history, observation, consultation caregiver and medical records by staff | - | - |

**Table 2** Measurements of pain, neuropsychiatric symptoms and physical function *(Continued)*

| | | | | | | |
|---|---|---|---|---|---|---|
| | | caregiver and medical records by staff | MDS for delusions and hallucinations<br>MDS items B5b, E1b, E4aa, E4da for agitation | | | |
| Williams 2005[43] | PGC-PIS, score =2, and 0–10 pain numeric rating scale | Registered nurses or licensed practical nurses and interview with overseeing supervisor | CSDD, score =7<br>CMAI, any behaviour at least weekly | Rating by care supervisors, registered nurses and licensed practical nurses | MDS-ADL<br>APAS<br>SMOI | Rating by care supervisors, registered nurses and licensed practical nurses |
| Zieber 2005[38] | DS-DAT, and a 7-point pain rating scale | Trained facility nurses, palliative care nurse consultants | PAS | Trained facility nurses | - | - |

*Abbreviations: MDS* Minimum Dataset, *ADL* Activities of Daily Living, *GMPI* Geriatric Multidimensional Pain and Illness Inventory, *GDS-15* Geriatric Depression Scale-15 short version, *PRADLI* Psychosocial Resistance to Activities of Daily Living Index, *GLDS* Geriatric Level of Dysfunction Scale, *PGC-PIS* Philadelphia Geriatric Centre Pain Intensity Scale, *CSDD* Cornell Scale for Depression in Dementia, *CMAI* Cohen-Mansfield Agitation Inventory, *SMOI* Structured Meal Observational Instrument, *HAM-D* Hamilton Rating Scale for Depression, *NPI* Neuropsychiatric Inventory, *PAINAD* Pain Assessment in Advanced Dementia, *STAI* State-Trait Anxiety Inventory, *AAS* Adjusted Activity Scale, *PPQ* Proxy Pain Questionnaire, *CNA* Certified Nursing Assistant, *RMBPC-NH* Revised Memory and Behaviour Problems Checklist-Nursing Home, *BEHAVE-AD* Behavioural Pathology in Alzheimer's disease, *PSMS* Physical Self Maintenance Scale, *VDS* Verbal Descriptor Scale, *KATZ* Index of Independence in Activities of Daily Living, *IADL* Instrumental Activities of Daily Living, *OARS/IADL* Older Americans Recourses and Services/Instrumental Activities of Daily Living, *VRS* Verbal Rating Scale, *DQoI* Dementia Quality of life, *APAS* Albert Patient activity Scale, *DS-DAT* Discomfort Scale - Dementia of Alzheimer Type, *PAS* Pittsburgh Agitation Scale

**Table 5** Correlates of pain and neuropsychiatric symptoms

| Correlates of pain and specified NPS | | | | | |
|---|---|---|---|---|---|
| First author | N | Pain: prevalence | Neuropsychiatric symptoms: prevalence | Correlates of pain with NPS | Quality of study |
| Ahn 2013[36] | 56577 | Not reported | Wandering 9 % | AOR 0.77 (95 % CI: 0.73-0.81) with wandering | 10 |
| | | | | Subsample without psychotropic medication | |
| | | | | AOR 0.72 (95 % CI: 0.63-0.83) with wandering | |
| | | | | (Adjusted for cognition, ADL, sociodemographics) | |
| Kunik 2005[34] | 99 | Pain mean 2.4 (SD 1.2) | Delusions/hallucinations mean 0.35 (SD 0.48) | r = 0.15 (p > 0.05) with psychosis | 8.5 |
| Leong 2007[35] | 225 | Pain 44 %, chronic pain 34 % | Anxiety 48 % | SOR 1.8 (95 % CI: 1.0-3.0) with anxiety | 8.5 |
| Norton 2010[42] | 161 | Not reported | BEHAVE-AD mean 6..4 (SD 29.2) | r = 0.15 (p = 0.08) for pain intensity and emotional behaviour problems | 9 |
| | | | RMBPC-NH mean 1.45 (SD 0.64) | r = 0.05 (p = 0.58) for pain intensity and resistiveness to care | |
| Torvik 2010[52] | 106 | Current pain in total group 55 %, in cognitive impaired group 52 % | Negative affect index (DQoL) mean 2.0 (SD 0.75), positive affect/humour index (DQoL) mean 3.4 (SD 0.9) | p < 0.01 for current pain and negative affect | 6.5 |
| | | | | p = 0.11 for current pain and with positive affect/humour | |
| Tosato 2012[3] | 2822 | Any pain 19 % (moderate/severe/ excruciating pain 13 %) | Behavioural symptoms 37 % Psychiatric symptoms 21 % | AOR = 0.74 (95 % CI: 0.55-1.0) with wandering | 11.5 |
| | | | | AOR = 1.4 (95 % CI: 1.08-1.8) with resistance to care | |
| | | | | AOR 1.5 (95 % CI: 1.07-2.03) with delusions | |
| | | | | AOR 1.06 (95 % CI: 0.80-1.41) with verbal abuse | |
| | | | | AOR 1.08 (95 % CI: 0.75-1.55) with physical abuse | |
| | | | | (Adjusted for age, gender, country, cognitive impairment, number of diseases, ischemic heart disease, stroke, falls, communication problems, and a flare-up of a chronic or recurrent condition) | |
| Volicer 2009[37] | 929 | Daily pain 29 %, less than daily pain 19 % | Verbally abusive not easily altered 2 %, physically abusive not easily altered 12 % | r = 0.07 (p = 0.03) for pain frequency and verbal abuse | 11 |
| | | | | AOR = 0.9 (p = 0.53) with resisting care | |
| | | | | AOR = 0.7 (p = 1.2) with verbal abuse | |
| | | | | AOR = 0.7 (p = 0.16) with physical abuse | |
| | | | Delusions 8 % | (Both multivariate models among others controlled for resisting care) | |
| | | | Hallucinations 9 % | | |
| Zieber 2005[38] | 58 | Not reported | Not reported | r = 0.46 (p < 0.01) for DS-DAT scores and resisting care | 8 |
| | | | | r = 0.42 (p < 0.01) for DS-DAT scores and aberrant vocalization | |
| | | | | Pain rating by palliative care nurse consultants: | |
| | | | | r = 0.51 (p < 0.01) with resisting care | |
| | | | | r = 0.40 (p < 0.01) with aberrant vocalizations | |
| | | | | Pain rating by facility nurse: | |
| | | | | r = 0.48 (p < 0.01) with resisting care | |
| | | | | r = 0.065 (p < 0.63) with aberrant vocalizations | |

**Table 5** Correlates of pain and neuropsychiatric symptoms *(Continued)*

| Correlates of pain and unspecified NPS | | | | | |
|---|---|---|---|---|---|
| First author | N | Pain: prevalence | Neuropsychiatric symptoms: prevalence | Correlates of pain with unspecified NPS | Quality of study |
| Black 2006[39] | 123 | Pain 63 % | Psychiatric disorders or behaviour problems 85 %, behaviour problems 67 % | SOR 1.9 (95 % CI: 0.7-5.3) with psychiatric/behaviour problems<br>SOR 1.2 (95 % CI: 0.5-2.5) with behaviour problems | 6.5 |
| Brummel-Smith 2002[40] | 104 (excluding those unable to self-report pain) | Moderate-severe pain 60 %<br>No-mild pain 40 %<br>50 subject unable to answer | ≥1 disruptive behaviours (wandering, verbal disruption, physical aggression, regressive behaviour, hallucinations)<br>70 % in dementia sample n = 154 | SOR 1.8 (95 % CI: 0.8-4.0) with ≥ 1 disruptive behaviour | 7 |
| Cipher 2004[4] | 234 | Persistent pain 72 % | Dysfunctional behaviours mean 4.4 (SD 0.76) | r = 0.22 (p < 0.05) with dysfunctional behaviours | 7.5 |
| Cipher 2006[41] | 277 | Acute pain 29 %<br>Chronic pain 59 % | - | r = 0.18 (p < 0.05) with GLDS mean behavioural intensity | 7.5 |
| Norton 2010[42] | 161 | Not reported | BEHAVE-AD mean 61.4 (SD 29.2)<br>RMBPC-NH mean 1.45 (SD 0.64) | r = 0.18 (p = 0.03) for pain intensity and disruptive behaviour problems<br>r = 0.05 (p = 0.53) for pain intensity and global need driven behaviours | 9 |
| Tosato 2012[3] | 2822 | Any pain 19 % (moderate/severe/ excruciating pain 13 %) | Behavioural symptoms 37 %<br>Psychiatric symptoms 21 % | AOR = 1.4 (95 % CI: 1.04-1.8) with socially inappropriate behaviour<br>(Adjusted for age, gender, country, cognitive impairment, number of diseases, ischemic heart disease, stroke, falls, communication problems, and a flare-up of a chronic or recurrent condition) | 11.5 |
| Williams 2005[39] | 331 | Pain 21 %, in nh 23 %, in rc/al 20 %<br>(self-report for subgroup mmse > 10<br>was higher: 39 % and 25 %) | Behavioural symptoms 58 % | OR = 1.1 (95 % CI: 0.49-2.29) and AOR = 1.2 (95 % CI: 0.57-2.36) with behavioural symptoms<br>(Adjusted for: sex, race, age, cognitive status, number of 10 comorbidities, impairments of 7 activities of daily living) | 10 |

*Abbreviations: AOR* Adjusted Odds Ratio, *ADL* Activities of Daily Living, *SD* Standard Deviation, *r* correlation coefficient, *SOR* Self-Calculated Odds Ratio, *BEHAVE-AD* Behavioural Pathology in Alzheimer's disease, *RMBPC-NH* Revised Memory and Behaviour Problems Checklist-Nursing Home, *DQoL* Dementia Quality of life, *DS-DAT* Discomfort Scale - Dementia of Alzheimer Type, *GLDS* Geriatric Level of Dysfunction Scale, *rc/al* residential care/assisted living, *MMSE* Mini Mental State Examination, *OR* Odds Ratio

**Table 6** Correlates of pain with physical function

| Correlates of pain and ADL or IADL | | | | | |
|---|---|---|---|---|---|
| First author | N | Pain: prevalence | Physical function: prevalence | Correlates of pain with ADL or IADL | Quality of study |
| Brummel-Smith 2002[36] | 104 (excluding those unable to self-report pain) | Moderate-severe pain 60 %, no-mild pain 40 % (50 subject unable to answer) | ≥1 ADL limitations<br>92 % in dementia sample (n = 154) | SOR 1.9 (95 % CI: 0.6-6.0) with ≥ 1 ADL limitation | 7 |
| Cipher 2004[4] | 234 | Persistent pain 72 % | ADL independency mean 0.09 (SD 0.99) | Correlations with GMPI 'pain and suffering'<br>r = −0.04 (α > 0.05) with ADL independency | 7.5 |
| Shega 2005[44] | 115 | Any current pain self-report 32 %, caregiver report 53 % | KATZ mean 8.5 (SD 2.7), IADL mean 15.3 (SD 3.9) | For self-report pain<br>No association ADL and IADL (p > 0.05)<br>For caregiver pain report<br>No association with ADL or IADL (p > 0.05) | 9.5 |
| Shega 2010[45] | 5549 | Moderate or greater pain: 35.8 % | Any IADL impairment: 66.5 % | OR = 1.74 (95 % CI: 1.15-2.62) with any iADL impairment<br>(Adjusted for demographics) | 9 |
| Torvik 2010[48] | 106 | Current pain in total group 55 %, in cognitive impaired group 52 % | Highly or moderate ADL dependent 36 % | p = 0.20 for current pain and ADL<br>SOR = 0.5 (95 % CI: 0.2-1.2) for current pain and ADL high/medium v.s. low | 6.5 |
| Tosato 2012[3] | 2822 | Any pain 19 % (moderate/severe/ excruciating pain 13 %) | No disability 8 %, assistance required 43 %, dependent 49 % | SOR 1.0 (95 % CI: 0.9-1.2) with ADL-dependent<br>SOR 0.9 (95 % CI: 0.75-1.09) with ADL assistance required<br>(Adjusted for age, gender, country, cognitive impairment, number of diseases, ischemic heart disease, stroke, falls, communication problems, and a flare-up of a chronic or recurrent condition) | 11.5 |

**Table 6** Correlates of pain with physical function *(Continued)*

| Correlates of pain and other functional impairments | | | | | |
|---|---|---|---|---|---|
| First author | N | Pain: prevalence | Physical function: prevalence | Correlates of pain with ADL or IADL | Quality of study |
| Black 2006[39] | 123 | Pain 63 % | Nutrition/hydration problems total sample 85 % | SOR 1.9 (95 % CI: 0.7-5.3) with nutrition/hydration problems | 6.5 |
| Brummel-Smith 2002[40] | 104 (excluding those unable to self-report pain) | Moderate-severe pain 60 %, no-mild pain 40 % (50 subject unable to answer) | ≥1 ADL limitations<br>92 % in dementia sample (n = 154) | SOR 1.6 (95 % CI: 0.6-4.2) with bladder incontinence | 7 |
| D'Astolfo 2006[44] | 140 | Pain 64 % (musculoskeletal pain 40 %) | Use of wheel chair 60 %<br>Requires assistance 34 % | SOR 1.5 (95 % CI: 0.7-3.0) with use of wheel chair or bedridden<br>SOR 1.0 (95 % CI: 0.5-2.0) with requires assistance<br>(Analyses in sample of no dementia-severe dementia) | 7 |
| Lin 2011[46] | 112 | Observed pain 37 % (PAINAD > =2) | Being restrained 46 %; observed care activities: bathing 43 %, assisted transfer 31 %, self-transfer 26 % | OR = 5.4 (95 % CI: 2.3-12.5) and AOR = 3.0 (95 % CI: 1.0-8.7) with being restrained<br>OR = 23.4 (95 % CI: 3.0-188) and AOR = 19.2 (95 % CI: 2.3-162) with bathing<br>OR = 29.7 (95 % CI: 3.6-242) and AOR = 11.3 (95 % CI: 1.2-102) with assisted transfer, both compared to self-transfer<br>(Adjusted for gender, age, wound, restraint, tube present in body, recent fall, severity of dementia and type of activity) | 12 |
| Williams 2005[43] | 331 | Pain 21 %, in nh 23 %, in rc/al 20 % (self-report for subgroup MMSE > 10 was higher: 39 % and 25 %) | Low activity 47 %, immobile 12 %<br>Low food intake 53 %<br>Low fluid intake 51 % | OR = 0.65 (95 % CI: 0.38-1.11) and AOR = 0.64 (95 % CI: 0.37-1.10) with low activity<br>OR = 1.1 (95 % CI: 0.49-2.29) and AOR = 0.8 (95 % CI: 0.37-1.69) with immobility<br>OR = 1.18 (95 % CI: 0.64-2.17) and AOR = 1.03 (95 % CI: 0.56-1.87) with low food intake<br>OR = 1.20 (95 % CI: 0.67-2.15) and AOR 1.14 (95 % CI: 0.66-1.99) with low fluid intake<br>(Adjusted for: sex, race, age, cognitive status, number of 10 comorbidities, impairments of 7 activities of daily living) | 10 |

*Abbreviations: SOR* Self-Calculated Odds Ratio, *ADL* Activities of Daily Living, *SD* Standard Deviation, *r* correlation coefficient, *GMPI* Geriatric Multidimensional Pain and Illness Inventory, *PAINAD* Pain Assessment in Advanced Dementia, *OR* Odds Ratio, *AOR* Adjusted Odds Ratio, *KATZ* Index of Independence in Activities of Daily Living, *IADL* Instrumental Activities of Daily Living, *nh* nursing home, *rc/al* residential care/assisted living, *MMSE* Mini Mental State Examination

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