Comparing the effect of non-medical mechanical restraint preventive factors between psychiatric units in Denmark and Norway

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Background: The use of mechanical restraint (MR) is controversial, and large differences regarding the use of MR are often found among countries. In an earlier study, we observed that MR was used twice as frequently in Denmark than Norway. Aims: To examine how presumed MR preventive factors of non-medical origin may explain the differing number of MR episodes between Denmark and Norway. Methods: This study is a cross-sectional survey of psychiatric units. Linear regression was used to assess the confounding effects of the MR preventive factors, i.e. whether a difference in the impact of these factors is evident between Denmark and Norway. Results: Six MR preventive factors confounded the difference in MR use between Denmark and Norway, including staff education (51%), substitute staff (17%), acceptable work environment (15%), separation of acutely disturbed patients (13%), patient-staff ratio (11%), and the identification of the patient’s crisis triggers (10%). Conclusions: These six MR preventive factors might partially explain the difference in the frequency of MR episodes observed in the two countries, i.e. higher numbers in Denmark than Norway. One MR preventive factor was not supported by earlier research, the identification of the patient’s crisis triggers; therefore, more research on the mechanisms involved is needed. Clinical implications: None of the six MR preventive factors presents any adverse effects; therefore, units in Denmark and Norway may consider investigating the effect of implementing, the identification of the patient’s crisis triggers, an increased number of staff per patient, increased staff education, a better work environment and reduced use of substitute staff in practice.

In Denmark and Norway, mechanical restraint (MR) can be legally performed when psychiatric inpatients pose a risk to themselves or others (1, 2). The procedure is primarily performed by nursing staff, and involves the use of leather or fibre belts to secure the patient to a bed. MR exposes patients to potential physical risks (3–7) and has negative psychological effects for many patients (8–12).

A Danish review (13) identified numerous MR preventive factors based on studies that target MR prevention. No MR preventive factors found in the review received the highest scientific recommendation grade.1 Furthermore, several of these MR preventive factors might be effective only in controlled research environments.

In an earlier retrospective association study (14), we found three MR preventive factors associated with low numbers of MR episodes in Denmark and Norway (mandatory review, patient involvement and no crowding). In that study, we eliminated the differences between the countries by making adjustments to make the findings more universal. However, focusing on the differences between the countries is important when the aim is to develop effective MR reduction programs in Denmark and Norway.

In a comparative study on the use of coercion in 11 European countries, including Denmark and Norway...
(15), Norway had the lowest rate of physical coercion (MR, seclusion and physical restraint/holding) with 29 inhabitants per 100,000 experiencing physical coercion. In comparison, Denmark had 122 episodes of MR per 100,000 inhabitants, and Norway had 87 episodes of MR per 100,000 inhabitants in 2007 (16, 17). The same tendency was observed in the subpopulation we investigated earlier (14); Denmark had 72 MR episodes per 100,000 inhabitants, and Norway had 42 MR episodes per 100,000 inhabitants. The lower frequency of MR episodes in Norway might indicate that more effective MR preventive factors have been implemented in Norway compared with Denmark or that MR preventive factors exhibit differing effects between the countries.

**Aim**
To examine how presumed MR preventive factors of non-medical origin may explain the differing number of MR episodes between Denmark and Norway.

**Material and methods**
A comparative study was conducted to investigate the degree to which the non-medical MR preventive factors identified in a previous review (13) were implemented in the psychiatric units and whether the chosen MR preventive factors association with the number of MR episodes differed between Denmark and Norway.

The following conditions must be present legally to initiate MR according to the Danish Mental Health Act (translated by the authors) (1):

Mechanical restraint may be used only when necessary to prevent a patient from

1) exposing their body or health or the body or health of others to danger,
2) pursuing or in any other way grossly molesting fellow patients, or
3) committing significant acts of vandalism.

These conditions are consistent with Norwegian legislation (translated by the authors) (2):

Restraints may be used on a patient only when absolutely necessary to prevent him or her from damaging him or herself or others or to prevent damage to buildings, clothing, inventory or other things.

This paper uses Bowers et al.’s (18) definition of MR: The use of restraining straps, belts or other equipment to restrict movement. Note that this definition refers only to the restraint of inpatients in psychiatric hospitals.

The MR preventive factors identified by the literature review (13) were included in an online questionnaire and sent to the clinical nurse managers for the purpose of quantifying whether they were implemented in the units. These managers were chosen because they had exclusive access to the requested information. The units were the smallest organizational collection of beds led by a clinical nurse manager.

**Time frame**
The Danish questionnaire was administered between 23 December 2009 and 28 May 2010, and the collected data pertained to 2008. The Norwegian questionnaire was administered between 29 October 2010 and 27 January 2011, and the collected data pertained to the previous 12 months, most of which occurred in 2010.

**Included participants**
The study included all psychiatric hospital units in Denmark \( n = 87 \) and Norway \( n = 96 \) that treated adult inpatients (18–65 years) and used MR for approximately 2 years prior to the year of investigation. MR did occur in Norway in settings other than hospitals; however, given that only 1.5% of recorded MR episodes in 2007 occurred in these settings (16) and that hospitals served as the primary focus of this study, these units were not included.

**Excluded participants**
The special high-security department in Denmark was excluded due to specific legislation concerning seclusion.

**Excluded outcome data**
If MR was used more than 25 times on the same patient during the investigation period, then the episodes of \( MR > 25 \) were excluded. Chance determined the units to which these patients were admitted, but the presence of these patients could significantly affect the units’ MR frequencies, distorting the results.

**Data collection: the questionnaire**
A questionnaire was developed based on the results from an earlier systematic literature review that focused on factors that might reduce the use of MR (13).

Each MR preventive factor was “translated” into questions to identify the degree to which the factor was present in the units.

Six factors were not included in the present study. Combined intervention programmes, were omitted because they were too complex to measure. The following four factors were omitted because they were not considered measured appropriately by the questionnaire: treatment of substance abuse and psychosis, patients perceived as a resource in their own treatment, pro necessitate [p.n.]/as-needed medication guided by individual patients, and care alliance. Lastly, music used as a diversion and for relaxation were omitted, because it were partially covered by another factor, activity-based nursing.

Cognitive milieu therapy and patient involvement and patient-centred care and patient involvement, were sepa-
rated into three factors: cognitive milieu therapy, patient-centred care, and patient involvement. Although patient involvement is part of cognitive milieu therapy and patient-centred care, it might also occur by itself. Leaving, 22 separate MR preventive factors to be included in the present study.

The questionnaire was developed by conceptualizing and operationalizing the MR preventive factors. To increase validity and reliability, we followed the Question Appraisal System [QAS-99 (19)] that was developed to identify problems in questionnaires, including the cognitive processes inherent to the question-answering process.

The construction and pre-testing of the questionnaire involved an eight-step appraisal of each item (QAS-99): reading, instructions, clarity, assumption, knowledge/memory, sensitivity/bias, response categories and others. The pre-test was conducted by creating a cognitive-test protocol that included probes for each item. The probes covered the aforementioned eight steps and consisted of several types: general (e.g., How did you reach this answer?); specific (e.g., Why do you believe MR is an intrusive and coercive measure?); understanding/interpretation (e.g., How do you define physical activity?); safety (e.g., How sure are you of your answer?); paraphrasing (e.g., Can you repeat the question in your own words?); and memory (e.g., How did you know that you had 56 MR last year?).

The pre-test consisted of cognitive interviews (20) of four clinical nurse managers individually using concurrent probing (21), in which verbal probes were asked immediately after a question. This protocol led to the revision of seven questions that were subsequently pre-tested in a group interview.

Data collection, administration, and processing, as well as error identification and the creation of electronic data files (22, 23), were administered using the electronic web-based survey system Enalyzer (2010).

The questionnaire was checked for test–retest reliability by asking three clinical nurse managers to answer the questionnaire a second time after a 3-month interval (The respondents were instructed not to check their previous answers). The estimated mean correlation between all of the first and second answers was reasonable (Kendall’s $\tau_{ab} = 0.75$). With regard to the Norwegian portion of the study, the questionnaire was translated and retranslated by JB and then checked by two healthcare professionals who were familiar with the subject. A pre-test was conducted to test face validity through cognitive interviews of seven clinical nurse managers. This test led to the revision of eight questions, mostly due to imprecise translations. Moreover, one question was added to the questionnaire due to different staff competences: psychologists in Norway are partially responsible for their patients’ treatment, which is not the case in Denmark.

Later, the outcome variable (i.e., the number of MR episodes) was re-examined. This procedure was necessary due to the confusing wording of a heading in the Danish questionnaire and the lack of precise numbers regarding the Norwegian patients who experienced MR more than 25 times (14 answer categories instead of the actual number were provided, which made the exclusion imprecise). The re-examination was accomplished by contacting all of the clinical nurse managers in Denmark and four of the clinical nurse managers in Norway. The respondent rate was 94%, and the results lowered the overall frequency of MR by 3.2%. A high correlation coefficient ($\tau_{Ken,b} = 0.89$) was found between the two answers, revealing that the confusing headline and the categorization error did not have an important effect.

A description of how the 22 dichotomized MR preventive factors were measured in the Supplementary Appendix to be found online at http://informahealthcare.com/doi/abs/10.3109/08039488.2014.996600.

**Background variables**

Several conditions might have affected the outcome. These conditions included unit size, bed occupancy, type of bed, reason for the MR, forensic provision, ethnicity other than Danish/Norwegian and type of unit. A description of the background variables included in the study is presented in Table 1.

Other variables, e.g., the unit’s population base, the country’s inhabitants and patient flow, could also affect the outcome; however, these variables were covered by the previously mentioned covariates. Unit type and unit size acted as proxy covariates [e.g., patient flow and population base were included in unit type; inhabitants were included in unit size, where the number of beds per 100,000 inhabitants in each country was very similar (Denmark = 23.96 and Norway = 22.81 beds per 100,000 inhabitants)].

A patient’s gender is most likely not associated with MR (24, 25); thus, we did not use gender as a covariate.

**Data analyses**

The data analyses were conducted in five steps. First, we analysed the difference in the frequency of MR episodes between the countries. Second, we analysed how the factors were individually associated with the number of MR episodes in Denmark and Norway separately. Third, we determined whether an interaction between the MR preventive factors and the country (second order interaction, SOI) existed. Fourth, we analysed the difference in the prevalence of the MR predictive factors between the two countries using Pearson’s chi-squared test ($\chi^2$). Fifth, we analysed the confounding effects of the MR preventive factors, i.e., the difference in the effect of the country in
models with and without the corresponding MR preventive factor expressed as a percentage \([\Delta \exp(B)]\); a percentage of greater than 10% was chosen to denote a difference.

Linear regression was used to estimate the associations among the frequency of MR episodes, the countries, and the MR preventive factors. To stabilize the variance, the outcome was logarithmically transformed. Hence, the regression coefficients are back-transformed [exponentiated; \(\exp(B)\)] and should be interpreted multiplicatively. Because the preventive factors were dichotomized, a regression coefficient \(\exp(B)\) indicates the average number of times MR increased for units where a factor was present compared with units where this factor was absent (e.g. if the result was \(\exp(B) = 0.42\), it should be interpreted as 0.42 times the average number of MR incidents without the MR preventive factor or 58% fewer MR episodes occur with the MR preventive factor than without). Except in the first analysis, where the dichotomized variable was “country”, here the regression coefficient \(\exp(B)\), indicates the difference between the countries in an average number of MR episodes.

All models except the fourth set of analyses (\(\chi^2\)-test) were additionally adjusted for background variables. Additionally, we adjusted for nesting of units in departments (17 departments contained two units each and three departments contained three units each), using Generalized Estimating Equations (GEE).

To account for multiple testing, a \(P\)-value \(/H_1^{0.01}\) was chosen to indicate significance. All analyses were performed using IBM SPSS Statistics for Windows, Version 19.0 (Released 2010; IBM Corp., Armonk, NY).

**Approval and ethics**
Questionnaires, such as the one included in the present study, do not require approval from the scientific ethical committee system in Denmark or Norway when the respondents are able to provide informed consent or when sensitive information is not collected. The Danish Data Protection Agency (Journal number: 2007-58-0015, PSV-
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2009-13) approved the data collection, and we received permission from the Danish Health and Medicines Authorities and the Danish Psychiatric Central Research Register to use the register data on the frequency of MR in Denmark (26).

This study followed the Ethical Guidelines for Nursing Research in the Nordic Countries (Northern Nurse Federation, 2003) and the Recommendations on Legal Protection of Persons Suffering from Mental Disorders Especially Those Placed as Involuntary Patients (27).

**Results**

A flowchart of the participating units can be found in Figure 1, and the annual number of MR episodes can be found in Table 2.

A difference in MR episodes was observed between the countries in a model that included the background variables [exp(B) = 1.92, P = 0.01] (Fig. 1, Table 2).

Table 3 indicates that a single MR preventive factor, staff education [exp(B) = 0.34, P = 0.00], was significantly associated with a lower frequency of MR episodes in Denmark. In Norway, three MR preventive factors were significantly associated with a higher frequency of MR episodes: cognitive milieu therapy [exp(B) = 7.46, P = 0.00], patient-centred care [exp(B) = 5.01, P = 0.00] and alarm systems [exp(B) = 3.72, P = 0.00]. Notably, for cognitive milieu therapy and patient-centred care, the confidence intervals were large, which makes the interpretation less precise.

We identified three incidents of interaction among the MR preventive factor, the countries and the frequency of MR episodes: cognitive milieu therapy (SOI, P = 0.00), patient-centred care (SOI, P = 0.01) and alarm systems (SOI, P = 0.00). Each of these factors exhibited a positive effect in Denmark [exp(B): 0.36, 0.41, and 0.18] and a negative effect in Norway [exp(B): 7.46, 5.01, and 3.72].

Six MR preventive factors were significantly different between the two countries: the identification of a patient’s crisis triggers (χ², P = 0.01), patient–staff ratio (χ², P = 0.00), staff education (χ², P = 0.00), acceptable work environment (χ², P = 0.01), substitute staff (χ², P = 0.00) and separation of acutely disturbed patients (χ², P = 0.00).

Lastly, we identified six MR preventive factors with confounding effects, i.e. the MR preventive factor acted as a confounder [Δexp(B) > 10%]: identification of the patients’ crisis triggers [Δexp(B) = −10%], patient–staff ratio [Δexp(B) = −11%], staff education [Δexp(B) = −51%], acceptable work environment [Δexp(B) = −15%], substitute staff [Δexp(B) = −17%] and separation of acutely disturbed patients [Δexp(B) = 13%]. In both countries, the following MR preventive factors was associated with lower numbers of MR episodes: identification of patients’ crisis triggers (Denmark, exp(B) = 0.65; Norway, exp(B) = 0.75), a higher patient–staff ratio (Denmark, exp(B) = 0.96; Norway, exp(B) = 0.62), higher levels of staff education (Denmark, exp(B) = 0.34; Norway, exp(B) = 0.76), better work environment (Denmark, exp(B) = 0.52; Norway, exp(B) = 0.55), reduced use of substitute staff (Denmark, exp(B) = 0.59; Norway, exp(B) = 0.65).

![Fig. 1. Flowchart of the units participating in the survey.](image-url)

**Table 2. Annual number of mechanical restraint (MR) episodes.**

|                       | Denmark and Norway (n = 90) | Denmark (n = 43) | Norway (n = 47) |
|-----------------------|----------------------------|-----------------|----------------|
| Annual number of MR episodes | 2927 – 1938 | 45.1 0–254 | 989 – 21.0 0–74 |
| Mean annual number of MR episodes per unit | 32.5 0–15.9 | 2.5 0–15.9 | 41.0 2.0 0–7.1 |
| Mean annual number of MR episodes per bed | 58 0–15.9 | 2.0 0–7.1 | 58 0–74 |

No., the number of MR episodes. Nine units accounted for 451 of the excluded MR episodes (≥ 25 per person), thereby leaving 1938 episodes in Denmark and 989 in Norway for analysis. The number of MR episodes per 100,000 inhabitants in this sub-sample is estimated from the number of MR episodes, the response percentages and the number of inhabitants the actual year.
Table 3: Differences in the effects of potential mechanical restraint (MR) preventive factors on the annual number of MR episodes in Denmark and Norway.

| MR preventive factors | Denmark | Norway | SOI: Interaction between the MR preventive factor and the country | $\chi^2$: Difference in the prevalence of the MR preventive factor between countries | $\Delta \exp(B)$: Difference in the effect of country |
|-----------------------|---------|--------|---------------------------------------------------------------|-------------------------------------------------|-------------------|
|                       | No.     | %      | 95% CI of $\exp(B)$ | $P$ | No. | %      | 95% CI of $\exp(B)$ | $P$ | $\Delta \exp(B)$ | % |
| Cognitive milieu therapy vs. no cognitive milieu therapy | 5       | 13     | 0.36 [0.11-1.16] | 0.09 | 1    | 3      | 7.46 [2.94-18.89] | 0.00* | 0.00* | 0.09 | 6 |
| Patient involvement vs. no patient involvement | 34      | 81     | 0.66 [0.26-1.71] | 0.40 | 37   | 86     | 0.60 [0.27-1.31] | 0.20 | 0.80 | 0.53 | -2 |
| Patient-centred care vs. no patient-centred care | 5       | 13     | 0.41 [0.12-1.38] | 0.15 | 4    | 10     | 5.01 [2.03-12.36] | 0.00* | 0.00* | 0.72 | 3 |
| Identification of the patient’s crisis triggers vs. no identification | 29      | 69     | 0.65 [0.38-1.10] | 0.11 | 40   | 93     | 0.75 [0.26-2.17] | 0.59 | 0.67 | 0.01* | 0.72 |
| Risk assessment vs. almost none or no risk assessment | 9       | 21     | 2.85 [1.28-6.36] | 0.01 | 17   | 37     | 1.39 [0.60-3.26] | 0.45 | 0.13 | 0.11 | 7 |
| Mandatory review vs. no mandatory review | 8       | 19     | 0.38 [0.15-0.97] | 0.04 | 7    | 15     | 0.53 [0.21-1.37] | 0.19 | 0.97 | 0.60 | -1 |
| Staff training (>50% vs. less) | 20      | 49     | 0.96 [0.45-2.06] | 0.91 | 25   | 53     | 0.62 [0.32-1.19] | 0.15 | 0.56 | 0.00* | -1 |
| Positive staff attitudes vs. less positive | 4       | 10     | 0.36 [0.12-1.38] | 0.15 | 13   | 28     | 1.28 [0.53-3.06] | 0.59 | 0.75 | 0.03 | 3 |
| Patient-staff ratio (>3 staff per patient vs. less) | 2       | 5      | 0.65 [0.26-1.71] | 0.09 | 17   | 37     | 0.69 [0.25-1.88] | 0.47 | 0.53 | 0.14 | -1 |
| Staff education (<3.5 years vs. less) | 3       | 7      | 0.34 [0.17-0.66] | 0.00* | 43   | 93     | 0.76 [0.28-2.04] | 0.59 | 0.05 | 0.00* | -51* |
| Staff experience (>5 years vs. less) | 36      | 84     | 0.81 [0.45-1.44] | 0.47 | 44   | 98     | 0.56 [0.14-2.19] | 0.41 | 0.84 | 0.02 | 1 |
| Debriefing, defusing vs. none | 28      | 72     | 0.79 [0.46-1.36] | 0.40 | 24   | 53     | 2.04 [1.07-3.89] | 0.03 | 0.02 | 0.52 | -3 |
| Positive patient responses to rules vs. negative responses | 32      | 78     | 0.61 [0.29-1.29] | 0.20 | 34   | 85     | 1.52 [0.49-7.44] | 0.35 | 0.80 | 0.42 | -1 |
| Activity-based nursing vs. no activity-based nursing | 15      | 38     | 0.78 [0.34-1.79] | 0.56 | 22   | 54     | 0.69 [0.25-1.88] | 0.47 | 0.53 | 0.14 | -6 |
| Acceptable work environment vs. poor work environment | 6       | 14     | 0.52 [0.22-1.25] | 0.14 | 17   | 40     | 0.55 [0.30-1.03] | 0.06 | 0.93 | 0.01* | -15* |
| No crowding vs. crowding | 19      | 51     | 0.59 [0.31-1.13] | 0.11 | 20   | 59     | 0.59 [0.27-1.14] | 0.11 | 0.22 | 0.53 | 6 |
| Substitute staff (<50 vs. more) | 8       | 19     | 0.59 [0.32-1.10] | 0.10 | 33   | 73     | 0.54 [0.25-1.18] | 0.12 | 0.33 | 0.00* | -17* |
| Staff opposition to MR (many vs. some) | 11      | 27     | 1.09 [0.47-2.54] | 0.84 | 17   | 39     | 0.70 [0.30-1.63] | 0.41 | 0.65 | 0.25 | -1 |
| Alarm systems (many and well-trained responses vs. less well-trained responses) | 3       | 7      | 0.18 [0.03-1.17] | 0.07 | 5    | 11     | 3.72 [2.16-6.41] | 0.00* | 0.00* | 0.50 | 4 |
| Communication (all staff possess communicative skills vs. less than all) | 8       | 20     | 1.56 [0.85-2.85] | 0.15 | 17   | 36     | 1.03 [0.51-2.10] | 0.93 | 0.43 | 0.08 | 3 |
| Well-maintained, clean and tidy surroundings (always vs. seldom) | 23      | 55     | 0.89 [0.42-1.87] | 0.75 | 29   | 63     | 1.03 [0.53-2.04] | 0.92 | 0.63 | 0.43 | 0 |
| Separation of acutely disturbed patients vs. no separation | 21      | 50     | 1.05 [0.46-2.40] | 0.90 | 38   | 83     | 1.94 [0.92-4.09] | 0.08 | 0.28 | 0.00* | 13* |

No., the number of units where the factor was present; %, the percentage of units where the factor was present; $\exp(B)$, the parameter estimate. The outcome variable (i.e. the number of MR episodes) was log-transformed. Hence, the $\exp(B)$ should be interpreted multiplicatively (e.g. in Denmark, cognitive milieu therapy results in 0.36 times the average number of MR incidents without cognitive milieu therapy (or 64% fewer MR episodes occur with cognitive milieu therapy than without). 95% CI of $\exp(B)$, 95% Wald confidence interval for $\exp(B)$; $P$, $P$-value; SOI, second order interaction, $P$-value of a test for the interaction between the MR preventive factor and the country, i.e. whether the effect of the MR preventive factor differs between the countries; $\chi^2$, $P$-value of a chi square test for the difference in the prevalence of the MR preventive factor in the units between the countries; $\Delta \exp(B)$, Differences in the effect of the country in models with and without the corresponding MR factor (confounding effect of the MR preventive factor) expressed as a percentage; negative $\Delta \exp(B)$ values should be interpreted as a MR preventive factor that minimises the difference between the countries. In the estimation of $\exp(B)$, SOI, and $\Delta \exp(B)$, we used linear regression and adjusted for the following background variables: unit size, bed occupancy, type of bed, reason for the MR, forensic provision, ethnicity and type of unit. Additionally, the nesting of units in departments was adjusted using Generalized Estimating Equations (GEE) techniques. *$P<0.01$. †$\Delta \exp(B)$:± 10%.
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Norway, exp(B) = 0.54), except more separation of acutely disturbed patients, which was associated with increased MR episodes (Denmark, exp(B) = 1.05; Norway, exp(B) = 1.94).

Discussion

Three potential MR preventive factors displayed very different effects in the two countries, which was demonstrated by significant interactions among the MR preventive factor, the countries and the frequency of MR episodes. These preventative factors included cognitive milieu therapy (SOI, \( P = 0.00 \)), patient-centred care (SOI, \( P = 0.01 \)) and alarm systems (SOI, \( P = 0.00 \)). None of the factors had a significant difference in prevalence (\( \chi^2, P = 0.09, 0.72, \) and 0.50). Therefore, it was difficult to interpret the differences in the effect based on the country \([\Delta \exp(B)]\) due to the interaction. It was also difficult to determine why these factors exhibited a different effect in the two countries. One explanation of why cognitive milieu therapy and patient-centred care were effective in Denmark could be that these two factors were well described as methods and included a treatment philosophy in Denmark. Therefore, in Denmark, these descriptions of care and treatment actually covered phenomena such as patient involvement and cooperation; this was, to our knowledge, not the case in Norway in 2010. Another potential explanation is that the limited number of units in Norway that had implemented the three MR preventive factors could be special units with fewer MR episodes. Although the three MR preventive factors were significantly associated with an increased number of MR episodes in Norway, we would not recommend that Norway implement less of these three factors given the small number of units that implemented the factors. Further research is needed to explore the different effects of these three MR preventive factors.

Six MR preventive factors exhibited a significant difference between the countries with regard to the frequency of MR episodes \([\Delta \exp(B)]\).

First, identification of a patient’s crisis triggers: units wherein the initial nurse evaluation of at-risk patients always contained a written evaluation of aggressive, self-mutilating or suicidal behaviours (e.g. crisis triggers, unique calming techniques, and coping strategies) vs. units where the initial evaluation only occasionally or never contained a written evaluation. This factor explains a large \([\Delta \exp(B) = -10\%]\) portion of the difference in MR episodes between the countries. The identification of a patient’s crisis triggers was supported by earlier research. In a well-designed before and after study, Jonikas et al. (28) observed a significant decrease (between 49% and 99%) in physical restraint episodes after patients were interviewed to determine their crisis triggers and personal crisis management strategies. In a reasonably designed cluster randomized controlled trial (RCT), Putkonen et al. (29) reported the same tendency, where seclusion and restraint time decreased by 51% after implementing six core strategies to prevent seclusion and restraint. In both studies, the effect was attributed to variables other than the patients’ crisis triggers. In a one-way case-crossover designed study, Fluttert et al. (30) reported that implementing the early recognition method (ERM) decreased the number of seclusions by 54%. The ERM is a technique for patients and staff to work systematically with the patients’ triggers (early warning signs), crisis intervention and coping strategies; this is the same identification procedure we asked the clinical nurse managers about in the questionnaire. Overall, the earlier research supports the finding that identification of a patient’s crisis triggers, is part of explaining the difference in MR use between the two countries. The mechanism involved in this process is probably that patients and staff earlier recognize sign of a forthcoming crisis, and together develop counteractions to avoid escalation of the crisis, thereby reducing the risk of a MR episode. Early prevention could constitute one of the most effective strategies to reduce MR episodes.

Second, patient-staff ratio: units in which the staff-to-patient ratio was higher than or equal to three-to-one on average vs. those units where this ratio was lower than three-to-one. In Denmark, the effect was small, possibly due to the small number of units where the staff-to-patient ratio was lower than three-to-one on average. The factor explains a large \([\Delta \exp(B) = -11\%]\) portion of the difference in MR episodes between the countries. The effects of the staff-to-patient ratio were partially supported by earlier research. Smith et al. (31) found a 66% decrease in restraint episodes. However, because several factors contributed to the effect, it is unclear what portion of the MR reduction was attributable to the 50% increase in staffing. Janssen et al. (32) found that seclusion was used more commonly when the number of patients per staff was greater in long-term wards. Donat (33) reported a significant association between increased staffing levels and decreased MR and seclusion numbers. However, Owen et al. (34) noted that the relative risk of violence increased with more nursing staff. In addition, Bowers et al. (35) reported that increased levels of aggressive incidents were associated with increased staffing. Nonetheless, both studies with opposite outcomes did not precisely target MR or seclusion but instead targeted violence and aggression; the results could be influenced by staff employment policies, wherein staffing levels are increased in units with more aggressive incidents. Our study most likely eliminated this problem by introducing “type of unit” and “type of bed” as confounders. Overall, the earlier research specific dealing with the same conditions does support the finding that, the staff to patient ratio, is part of explaining the difference in MR use between the two countries. The mechanisms involved in
higher staffing levels could be that the staff would be more able to observe, interact and cooperate with the patients, probably reduce the number of stressed staff, thereby calming the environment, having more personal resources to positive reinforcement, support, and communication, hopefully creating a more empowering and recovery orientated environment for the patients.

Third, staff education: units wherein the staff received basic training for at least 31/2 years vs. units where the staff had less than 31/2 years of training. The factor explains a large portion [Δexp(B) = −51%] of the difference in MR episodes between the countries. Staff education was supported by earlier research. Janssen et al. (32) reported that seclusion was used more commonly in units with less educated staff in the long-term wards. Gim et al. (36) found a significant difference between psychiatric trained and non-psychiatric trained staff in identifying and managing precipitants of violence. In a large 20-year analysis of 1,565 mental health workers, Flannery et al. (37) found that staff who were victims of patients’ aggressions were less formally educated and less trained. None of the studies was an RCT, but otherwise well designed, so it is reasonable to deduce, that earlier research supports the finding that, staff education, is part of explaining the difference in MR use between the two countries. Higher basic education among staff is part of explaining the difference in MR use between the two countries. Whatever part of the work environment partly explains the difference in MR episodes.

Fourth, acceptable work environment: units where a workplace environment assessment was present, no or only insignificant physical or mental work-environment problems existed, and the overall work environment was evaluated as acceptable vs. units where the workplace environment was not assessed, more work-environment problems existed, and the overall work environment was evaluated as poor. This factor explains a large [Δexp(B) = −15%] portion of the differences in MR episodes between the countries. An acceptable work environment is somewhat complex because the work environment is a mix of leadership, degree of order, organization, staffing, training, crowding, etc. De Benedictis et al. (38) reported that several organizational factors, e.g. team climate, staff perception of aggression and interaction of team-members, were associated with increased use of seclusion and restraint. Hanrahan et al. (39) observed a relationship between psychiatric nurses’ work environments and inpatients’ environments. van der Schaff et al. (40) reported a number of building design features that had an effect on seclusion and restraint. Virtanen et al. (41) indicated that patient overcrowding was associated with violent assaults towards employees. Huckshorn (42) found that leaders played a critical role in reducing seclusion and restraint. Camerino et al. (43) found a significant association between work-related factors and some types of violence. Some of the other examined factors are also part of the overall work environment, such as staff training, staff/patient ratio, etc. Overall, the research that supports the association between MR and work environment includes many parts of a healthy work environment, and it supports the finding that the work environment partly explains the difference in MR use between the two countries. Whatever part of the environment that creates a positive work environment, the wellbeing of the staff is most certainly affecting the wellbeing of the patients, so when staff experiences a more positive work environment the patient probably experience a more positive environment.

Fifth, substitute staff: units in which substitute staff was used less than 50 times (8-h shifts) over the year vs. units where these employees were used greater than or equal to 50 times. The factor explains a large [Δexp(B) = −17%] portion of the difference in MR episodes between the countries. The effects of substitute staff were supported by earlier research. Bonner et al. (8) found that both patients and staff discriminated between permanent and regular staff. Bowers et al. (44) reported that adverse incidents were more likely to occur during weeks where regular staff was absent. In another study, Bowers et al. (35) noted that increased levels of aggression were associated with an increased use of bank and agency staff. None of the studies was an RCT, but all the studies indicate similar results, supporting less use of substitute staff. The reason for this finding could be that substitute staff lacks knowledge of the unit structures, processes and patients, thereby creating insecurity and disturbances in the everyday life of the unit among some of the most vulnerable patients. This could be a stressing factor for the patients creating more aggressive or self-destructive behaviour—hence, more MR episodes.

Sixth, one factor, separation of acutely disturbed patients, had different results: units that were able to separate acutely disturbed patients from other patients vs. units that were unable to separate patients. The factor explains a large [Δexp(B) = 13%] portion of the difference in MR episodes between the countries. This negative association was not supported by earlier research; in fact, the opposite result was indicated. In a qualitative content analysis study, Meehan et al. (45) noted that patients proposed that the separation of acutely disturbed patients would reduce the number of aggressive incidents. Overall, this result is not supported by earlier research. Therefore, more research is needed to explore the mechanisms involved in placing one or few patients in a separate and isolated part of the unit.

**Limitations**

Several limitations must be considered when examining the results.
First, some confounding covariates might be missing from the analyses. We believe that we included the most important covariates or covered the effects of others by proxy (46), e.g. patients who experience MR could be more aggressive or self-mutilating in one of the countries—hence, acting as a confounder. However, one earlier study that assessed aggressive behaviour (47) did not report large differences between Denmark and Norway. Additionally, some of the covariates (number of forensic patients, type of bed and the reason for the MR) could eliminate portions of the difference. Therefore, it is not likely that the potential differences in aggressive or self-mutilating patients would influence the results.

Second, recall bias is possible, especially for the Danish data; the clinical nurse manager had to recall all MR preventive factors as well as the conditions and number of MR episodes from 2 years ago. The outcome variable (i.e. the number of MR episodes) were validated or re-examined, and this did not reveal significant recall bias with regard to the outcome variable. Additionally, recall bias could affect the results if the MR preventive factors had only been implemented for a portion of the year. Thus, this recall bias would most likely only increase the effect on patient involvement. Nevertheless, we must consider the possibility of recall bias with regard to some variables.

Third, three participants answered the questionnaires twice during a 3-month interval to check the test–retest reliability. Although three participants are insufficient to calculate reliability properly, the results indicate no substantial difference in the measured constructs between the two administrations.

Fourth, selection bias—the non-responders’ reasons for failure to reply were reviewed, and no systematic differences were observed between responders and non-responders. Reviewing the Danish National Register on coercion, we found that 49% of responding units were “responsible” for 52% of the MR episodes in the same population, suggesting minimal differences in MR episodes between responders and non-responders; however, no proper drop-out analysis was conducted. Thus, the results most likely can be generalized to the population of both countries. Transferring the results to other countries, however, would require a thorough examination of their cultures, legislation and other relevant factors.

Finally, when data were reanalysed to include patients who experienced MR more than 25 times, the results changed only marginally. Therefore, the exclusion of the patients who experienced MR more than 25 times did not affect results.

**Conclusion**

The comparison of these MR preventive factors may contribute to better understanding of the phenomenon of MR, but it is important to acknowledge that this type of comparative research does not allow for cause–effect conclusions. Thus, we cannot claim that the implementation of these potential preventive measures in Denmark and Norway would reduce the number of MR episodes. More high-quality studies are needed to investigate the identification of a patient’s crisis triggers, an increased number of staff per patient, increased staff education, better work environment, reduced use of substitute staff, and separation of acutely disturbed patients.

**Notes**

1. The review was a a systematic review combining qualitative and quantitative research, so the highest recommendation grade could be: qualitative; at least one high-quality meta-synthesis, systematic review, or meta-summary, or a body of high-quality evidence, or quantitative; at least one meta-analysis, systematic review or one or a body of high-quality RCT.

2. **STEP 1: READING:** Determine if it is difficult for the interviewers to read the question uniformly to all respondents. **STEP 2: INSTRUCTIONS:** Look for problems with any introductions, instructions or explanations from the respondent’s point of view. **STEP 3: CLARITY:** Identify problems related to communicating the intent or meaning of the question to the respondent. **STEP 4: ASSUMPTIONS:** Determine whether there are problems with assumptions or the underlying logic. **STEP 5: KNOWLEDGE/MEMORY:** Check whether respondents are likely to not know or have trouble remembering information. **STEP 6: SENSITIVITY/BIAS:** Assess questions for sensitive nature or wording, and for bias. **STEP 7: RESPONSE CATEGORIES:** Assess the adequacy of the range of responses to be recorded. **STEP 8: OTHER:** Look for problems not identified in Steps 1–7 (19).

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Supplementary material available online
Appendix: A description of mechanical restraint (MR) preventive factor measurements