



Effect of Delirium Prevention Program on Delirium Occurrence and the Length of Intensive Care Unit (ICU) Stay: A Systematic Review and Meta-Analysis

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Abstract

Background: ICU patients typically experience diverse kinds of distress factors, which make them vulnerable to delirium thereby resulting in a higher rate of delirium occurrence. We aimed to review systematically current states of preventive nursing intervention in ICUs, and to analyze delirium occurrence and the length of ICU stay to provide suggestions for the preventive nursing practice in ICU.

Methods: Data collection was done with literature search databases including PubMed, Ovid-MEDLINE, EMBASE, CINAHL, KMBase, KoreaMed, Korean Studies Information Service System (KISS), Korea Institute of Science and Technology Information (KISTi), Research Information Service System (RISS) and with hand searching, from Apr 20 to May 10, 2020. Two researchers independently selected research literature, and three researchers summarized and identified related variables based on data extraction methods.

Results: Overall, 236 articles identified, 11 articles met the inclusion criteria for review. The systematic review of the contents of preventive nursing intervention other than drug administration rendered the four types of intervention. The Peto odds ratio (OR) of the rate of delirium occurrence appeared as 0.29 (95% Confidence Interval (CI)=0.20~0.43) which was statistically significant ($Z=6.23, P<.01$) in both group. The magnitude of the effect for the length of ICU stay demonstrated insignificant values, Mean difference (MD) -0.23 (95% CI= $-0.51\sim 0.05$) ($Z=1.60, P=.11$).

Conclusion: For management of delirium among ICU patients, multi-component intervention packages, suitable for care setting in ICUs, need to be taken into account for the preparation of nursing intervention for prevention of delirium applicable to nursing practices.

Keywords: Delirium; Intensive care unit; Systematic review; Meta-analysis

Introduction

Delirium is a manifestation of acute brain dysfunction defined by the Diagnostic and Statistical Mental Disorders (DSM-5) as a disturbance in attention and awareness develops over a short

period, and fluctuates. It is accompanied by a change in cognition (1). ICU Patients typically experience diverse kinds of distress factors, such as pain and anxiety due to serious underlying dis-



eases, drugs, operations, diverse kinds of invasive treatments, mechanical ventilation, hypotension, hypoxia, metabolic disorders, inhibition zones, and environmental factors that disturb the sleeping cycle, etc., which make them vulnerable to delirium thereby resulting in a higher rate of delirium occurrence. Approximately 12.0%-63.0% of patients in ICU have been reported to experience delirium occurrence in Korea (2,3). The incidence of adult patients in ICU was round of 30% and the highest prevalence was in ICU patients undergoing mechanical ventilation and reaches over 50% (4-6).

Delirium leads to ventilator delays, prolonged intensive care stays, and affects long-term care facility admissions and a higher mortality (6-8). The delirium has been reported as a strong factor of prediction for the extension of entire hospitalization period and the length of ICU stay, and was found to be in correlation with a survival rate of 6-months and decreased cognitive function in inpatients at the time of discharge from the hospital (9,10).

Therefore, the paranoid and disturbed thinking, observed in patients suffering from delirium, frequently led to falling from the sickbed and behavioral problems, such as spontaneous detachment of catheter, etc., thereby resulting in difficulties in nursing and treatment and an increase in the burden of administrative cost. The psychological burden, imposed on guardians of patients and adjacent patients has accelerated accordingly and consequently became a factor leading to an increase in total medical expenses (11).

The exact causes of delirium in ICU are hard to identify and typically require long-term treatment plans, thus drug administration is frequently provided. However, drug administration may aggravate the symptoms of delirium or result in inhibition of respiration due to the sedative effect of the drugs, or may cause aspiration pneumonitis (12). These adverse effects frequently cause higher risk in old patients or seriously ill patients with higher severity; thus special care should be taken while the administration of drugs for the treatment of delirium. For better prognoses, control and treatment of serious cases should be expand-

ed by focusing on the overall reduction in pain including anxiety and delirium, as well as treatment of underlying diseases. In particular, the prevention of risk factors before the generation of delirium and early treatment is recommended in contrary to the post-treatment of delirium (8, 9).

According to the guidelines prepared by the Academy of Certified Case Managers (ACCM) in America, the foundation at an intermediate level, supporting effect of an intervention such as early mobility, was identified (9). The guidelines of the National Institute for Health and Clinical Excellence (NICE), revised recently, also recommend serial intervention for the prevention of delirium comprising the intake of the appropriate amount of water, encouragement of exercise or articular mobilization, participation in activities of cognitive stimuli, and provision of pertinent lighting and definite signals, etc. (13).

Concerning the contents of components for intervention, the strategies of intervention with multi-components compared to the intervention with a single element, are spotlighted so that the multi-component intervention targets several risk factors simultaneously. In the results of the systematic review in 21 studies obtained from studies on nursing intervention, the concurrent application of more than 6 interventions has been reported so that it could bring greater potential with the capability of improving clinical consequences (14). In addition, the multi-components intervention has the advantage of providing effective consequences to be attained in the absence of complete compliance. Barnes-Daly et al. (15) applied the bundle of multi-components and reported a 2% increase in days of absence of delirium in accordance with a 10% increase in complete compliance of the entire bundle.

However, Hering and colleagues (16) conducted systematic review and meta-analyses of papers to identify the effects of preventive nursing intervention upon the occurrence of delirium in ICUs, wherein the preventive nursing intervention of physical and cognitive therapies were found with no effect on the generation of delirium and length of ICU stay. The effects of environmental

intervention and multi-component intervention and the preventive nursing intervention were not found. Bannon et al. (17) also analyzed the effect of intervention other than drug administration and reported that they did not identify the effect of the intervention on the generation of delirium, and thereby insisted the effects of decreasing incidence rate of delirium in serious patients based on nursing intervention, other than present drug administration, have no grounds.

On the contrary, Kang et al. (18) conducted meta-analyses on nursing intervention for the prevention of delirium and reported valid results of the incidence rate and period of duration of delirium. Thus, the effectiveness of non-drug intervention for the improvement in the occurrence of ICU-acquired delirium is yet to reach definite conclusions (9). Currently, there are no definite indicators to guide the application of non-drug nursing intervention for seriously ill patients exhibiting complex and more risky factors of delirium, due to which the clinical application of non-pharmacological intervention is still limited (17). Nevertheless, the medical service personnel taking care of seriously ill patients need effective non-drug and acceptable intervention (19).

Thus, the research team conducted the systematic review and meta-analysis on prior domestic studies that reported the nursing interventions for the prevention of ICU acquired delirium, to identify current states of preventive nursing intervention in ICUs, and to analyze delirium occurrence and the length of ICU stay to provide suggestions for the preventive nursing practice in ICU.

Methods

This study was conducted by the systematic literature review reporting guidance (20) presented by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) group.

Criteria for the Selection of Data

In this study, the key questions (population, intervention, comparison, and outcome (PICO)) were selected according to the Cochrane Hand-

book for Systematic Reviews of Interventions (21). **Population:** Refers to the patients aged over 19 yr treated in ICUs; the types of ICU did not limit the selection of subjects of the present study. **Intervention:** Refers to the nursing intervention other than drug administration for the prevention of delirium; no limitations on the numbers and types of preventive nursing intervention were imposed (2). **Comparison:** The group that received usual care, provided for the prevention of delirium of critically ill patients, was selected as the control group (2), and the **'Outcome'** was determined by employing measurements of delirium occurrence and the length of ICU stay after application of preventive intervention.

Contents of the population, intervention, and comparison among selected key questions were included in the criteria for data selection. On the contrary, following studies involving subjects other than critically ill patients concerning preventive nursing interventions of application of drug administration for prevention of delirium, and studies other than observatory or experimental ones, such as review articles, were excluded from the data selection.

Search for Data

The search for data was carried out from April 20 to May 10, 2020, for which the two researchers with experience in meta-analysis participated independently in the search. The search for papers pertinent to this study comprised PubMed, Ovid-MEDLINE, EMBASE, CINAHL, KMBASE, KoreaMed, KISS, KISTi, and RISS.

Besides, the search engines and sites, such as Google Academic Search and the Journal of Korean Society of Nursing Science, etc., were referred through manual operation. The keywords employed for the search of the population were 'critically ill patients', 'adult patients', and 'inpatients in ICUs'. While those used for the search of intervention comprised of the combination of conceptual words, such as 'delirium', 'prevention of delirium', 'education for delirium', 'education of prevention of delirium', and 'intervention', or 'non-drug intervention', 'program', 'therapies'

etc., for which no limit was set for the year of publication of the respective papers.

Data Selection and Extraction

The papers retrieved from each database were screened by exploiting the 'EndNote v7.8' to remove the duplicated ones. The remaining papers were included in the primary screening conducted by the two researchers, who checked the title and abstract of each paper according to the criteria developed for data selection and exclusion. The papers selected for the review and analysis conducted in the present study were selected among primarily selected papers by the two researchers who exploited identical processes and criteria developed for selection and exclusion of papers. In the case of disagreement on the selection or exclusion of papers between the two researchers, the corresponding papers were forwarded to the discussion of entire researchers to attain consensus on either selection or exclusion of each paper based on the existing criteria.

Qualitative Assessment of Papers

For the qualitative assessment of a randomized controlled trial, the RoB 2.0 (Risk of Bias 2.0) developed for randomized controlled studies by Cochrane Collaboration was used (21). In addition, the studies on Non-Randomized Controlled Trial (non-RCT) were appraised by employing the RoBANS 2.0 (Risk of Bias Assessment tool for Non-randomized Studies 2.0), the qualitative assessment tool developed by the National Evidence-based Healthcare Collaborating Agency (NECA) (22). Qualitative assessment of each paper was conducted by the three researchers independently upon securing of the original text of each paper, for which the cases of disagreement of the assessment were forwarded to discussions of the three researchers to attain an agreement thereon.

Methods of Data Analysis

Magnitudes of the effect of a nursing intervention program for the prevention of delirium upon incidence rate of delirium and length of stay of patients in ICUs were calculated; the statistical

analyses conducted in the study exploited the Review Manager 5.3 version developed by the Cochrane Collaboration. The binary data of delirium occurrence were obtained from the experimental group and control group of subjects by taking the number of patients of observed delirium as the frequency of incidence of delirium for the meta-analysis.

And for the magnitude of the effect of the nursing intervention, the Peto OR was calculated by employing Peto's estimation. Peto's method can only be used when the odds ratios are pooled. When using Peto's method, Corrections for zero cell counts are not required (23). In this study, the frequencies of the two subject studies in the experimental group appeared as zero. Therefore, we selected Peto OR as the analysis method.

The magnitudes of the effects on the length of stay of patients in ICUs were obtained by using the MD of measurements. The presence of heterogeneity between the subject studies was determined by conducting the chi-square test and Higgin's I^2 test. Respective values of Higgin's I^2 representing the presence of heterogeneity of 0%, 25%, 50%, and over 75% were appraised as absence, the smaller magnitude of presence, the middle-range magnitude of presence, and bigger magnitude of presence, respectively (21). With regards to the analysis of the effects of nursing intervention on delirium occurrence conducted by employing Peto's estimation, the fixed-effect model was used for the analysis thereof regardless of the presence of heterogeneity. The length of stay of patients in ICUs was also used for the fixed effects model since the presence of heterogeneity thereof appeared below 50% (24). The publication bias of studies included in analyses of the magnitudes of effects of delirium occurrence was tested by employing the funnel plot, while the publication bias of the papers on studies included in the analysis of length of stay of patients in ICUs was not tested because the number of the papers was only five (22).

Results

Data Selection

The two researchers examined the original text independently, from which the final 11 papers were selected for the systematic review and meta-analyses that were conducted in the present study (Fig. 1).

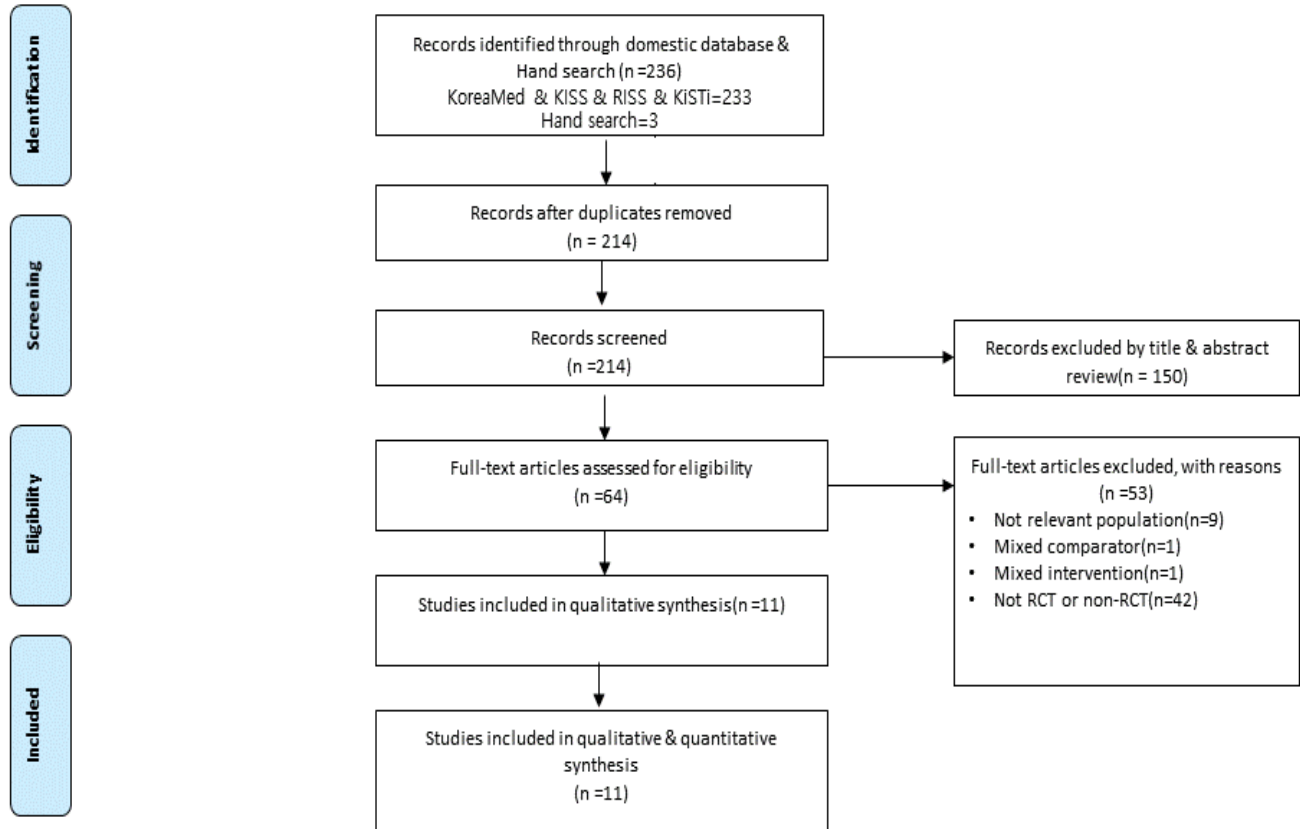


Fig. 1: Flow diagram of study selection process

Qualitative Assessment

The risk of bias of 10 papers of non-RCT was appraised by using the RoBANS 2.0 from which the 3 domains of comparability, selection of subject group, and assessment of results were appraised as 'low' concerning the risk of bias. The domain of blinding assessor was appraised as 'higher' risk of bias with the 5 papers. In the domain of incomplete data of results, 4 papers ap-

peared as 'higher' risk of bias. The 5 domains of the risk of bias of one paper of RCT was appraised according to the algorithm of assessment, from which the 'higher' risk of bias, in the domain of change from the originally intended intervention, appeared by which the final assessment of 'higher' risk of bias was determined (Table 1).

Table 1: Characteristics and Quality Assessment of the Studies (n=11)

No	Studies			Quality Assessment Tools							
	Author (Year)	Design	ICU type	ROB 2.0							
				Randomization	Deviation from intended intervention	Missing outcome data	Measurement	Selection of result	Total	-	-
S1	Moon & Lee (2014)	RCT	ICU	Low	High	Low	Low	Low	High	-	-
				RoBANS 2.0							
				Comparability of control group	Selection of participants	Confounding variables	Measurement of intervention (exposure)	Blinding of outcome assessment	Measurement of outcomes	Missing outcome data	Selection of the reported results
S2	Lee et al.(2012)	non-RCT	ICU	Low	Low	Low	Low	High	Low	High	High
S3	Jeong (2019)	non-RCT	NRICU	Low	Low	Low	Low	Low	Low	High	Low
S4	Rho (2015)	non-RCT	MICU	Low	Low	Low	High	Low	Low	Uncertain	Low
S5	Sim (2015)	non-RCT	SICU	Low	Low	Low	High	Low	Low	Uncertain	Low
S6	Lee et al.(2018)	non-RCT	NRICU	Low	Low	High	Low	High	Low	Uncertain	Low
S7	Kim (2013)	non-RCT	CSICU	Low	Low	High	Low	High	Low	Low	Low
S8	Lee (2014)	non-RCT	EICU	Low	Low	Low	High	Low	Low	Uncertain	Low
S9	Song (2015)	non-RCT	Stroke Unit	Low	Low	Low	High	Low	Low	Low	Low
S10	Hwang (2017)	non-RCT	SICU	Low	Low	High	Low	High	Low	High	Low
S11	Sakong & Kim (2018)	non-RCT	SICU	Low	Low	High	Low	High	Low	High	Low
	sub total			Low:10	Low:10	Low: 6 High: 4	Low: 6 High: 4	Low: 5 High: 5	Low: 10	Low: 2 High: 4 Uncertain: 4	Low: 9 High: 1

RCT: Randomized Controlled Trials, n-RCT: Non-randomized Controlled Trials

Systematic review on Preventive Nursing Intervention

The results of the systematic review of 11 studies on preventive nursing intervention for the prevention of delirium in ICUs are summarized in

Table 2. The papers corresponding to each study were all published from 2012 to 2019 comprising 5 papers (45.5%) published in the journal of academic society, 10 non-RCT papers (90.9%), and one RCT paper (9.1%).

Table 2: Characteristics of the Research intervention (n=11)

No	Patients			Interventions									Comparisons	Outcomes				
	SS/ Male (DR) n/n (%)	Age m (sd)	Contents	Classification by Inouye et al.										Starting days	Lasting days	Number of times per day	Primary	
Orientation	CI	SD	I	VI	HI	DH	Delirium occurrence (%)	Tool	ICU days (days)									
S1	E:60/30 (7.7) C:63/29 (8.7)	E:7.0 (13.8) C:6.9 (12.4)	Evidence-based protocol for preventing delirium in ICU	O	X	X	O	O	O	O	O	1st Day	7th Day	1 time	UC	E:20.0 C:33.3 (p=0.9)	CA-M-U	E:10.8 C:10.0 (p=.68)
S2	E:13/10 (31.6) C:15/6 (34.8)	E:6.8 (13.8) C:6.1 (13.2)	music therapy+ environmental Intervention - headphones - earplugs - sleep shade	X	X	O	X	X	O	O	X	1st Day	5th Day	1 time	UC	E:53.8 C:46.7 (p=.70)	CA-M-U	-
S3	E:29/13 (12.1) C:32/18 (3.0)	E:6.759 (13.0) C:6.15 (17.3)	music therapy+ environmental Intervention - headphones - earplugs - sleep shade	X	X	O	X	X	O	O	X	3rd Day	7th Day	1 time	UC	E:0.0 C:34.4 (p<.011)	CA-M-U	-
S4	E:27/17 (10.0) C:29/21 (3.3)	E:6.46 (16.5) C:6.54 (11.5)	Evidence-based protocol for preventing delirium in ICU	O	O	X	O	O	O	O	X	unknown	4th Day	1st:1 time 2nd-3rd: 2 times 4th:1 time	UC	E:18.5 C:27.6 (p=.42)	CA-M-U	E:12.1 C:17.3 (p=.12)
S5	E:44/30 (12.0) C:44/29 (12.0)	E:5.46 (12.2) C:5.82 (16.0)	Evidence-based protocol for preventing delirium in ICU	O	X	X	O	X	O	O	O	1st Day	3th Day	4 times	UC	E:18.2 C:38.6 (p=.03)	CA-M-U	-
S6	E:42/23 (0.0) C:45/23 (0.0)	E:5.95 (13.2) C:5.8 (8.0)	Evidence-based protocol for prevent-	O	O	X	O	X	O	O	O	1st Day	7th Day	3 times	UC	E:2.4 C:20.0 (p=.01)	CA-M-U	E:2.8 C:3.2 (p=.41)

S7	E:23 /12 (0.0) C:26 /15 (0.0)	E:7 1.21 (7.0) Nursing Practice Guide- line for the Man- age- ment of Acute Confu- sion	ing deliri- um in ICU	O	X	X	O	O	O	O	X	1st Day	3th Day	1st:1 time 2nd: 3 times 3rd:2 times	UC	E:13. 0 C:38. 5 (<i>p</i> =.04)	CA M- IC U	-
S8	E:25 /15 (37. 5) C:25 /14 (37. 5)	E:6 7.2 (12. 7) C:6 8.2 (13. 6)	Elder Life Pro- gram + envi- ron- men- tal inter- ven- tion + family presen- tation	O	O	X	O	X	O	O	X	1st Day	3th Day	Orienta- tion:3time s Caregiver: 2 times Sleep: 1 time	UC	E:20. 0 C:48. 0 (<i>p</i> =.03)	Nu- - DE SC	-
S9	E:54 /29 (1.8) C:54 /24 (1.8)	E:7 4.9 (6.1)) C:7 3.7 (6.7))	NICE deliri- um clinical guide- line	O	X	X	O	O	O	O	O	1st Day	un- kno wn	3 times	UC	E:7.4 C:24. 1 (<i>p</i> =.02)	DO S	E:2.9 C:4.4 (<i>p</i> =.01)
S10	E:35 /15 (37. 5) C:38 /18 (32. 1)	E:7 6.0 (8.0)) C:7 7.2 (6.6))	modi- fied NICE deliri- um clinical guide- line - Elder Life Pro- gram - family presen- tation	O	O	X	O	O	O	O	X	1st Day	2nd Day	3 times	UC	E:5.7 C:26. 71 (<i>p</i> =.04)	CA M- IC U	E:4.1 C:4.6 (<i>p</i> =.24)
S11	E:33 /19 (5.7) C:31 /20 (11. 4)	E:7 1.1 (5.7)) C:6 9.8 (6.0 3)	modi- fied NICE deliri- um clinical guide- line	O	X	X	O	O	O	O	O	1st Day	1st Day	3 times	UC	E:0.0 C:19. 3 (<i>p</i> =.01)	CA M- IC U	E:2.4 C:2.5 (<i>p</i> =.55)
SS(<i>n</i>) Total 787 E:385, C:402 % Man(<i>n</i>) E:55.3 C:54.0 Mean DR(%) E:14.2, C:13.1 Mean Age E:67.8 C:66.5				9	4	2	9	6	11	11	5							

SS: Sample Size, DR: Dropped Rate, E: Experimental group, C: Control group CI: Cognitive impairment, SD: Sleep deprivation, I: Immobility, VI: Visual impairment, HI: Hearing impairment, DH: Dehydration
UC: usual care, CAM-ICU: Confusion Assessment Method, Nu-DESC: Nursing Delirium Screening, DOS: Delirium Observatio

The systematic review of the contents of preventive nursing intervention other than drug administration rendered the following four types of intervention. First, the five nursing interventions consisted of risk factors presented in prior studies and the corresponding preventive strategies. Second, the three nursing interventions of participation of family members were integrated with the Elder Life Program (25) based on Delirium Clinical guidelines presented by NICE. Third, the Elder Life Program (25) that was integrated with one nursing intervention incorporated the participation of family members and environmental intervention. Fourth, the two nursing interventions incorporated music therapy and environment modified by employing sleeping eye-bandage and earplugs. Besides, the contents, identified by author(s) or described in the original text, and references thereof, were examined in terms of the 8 protocols for the 6 risk factors of delirium targeted in the Elder Life Program (25) for the analysis of contents of preventive nursing intervention in ICUs. With regards to the point of initiation of nursing intervention, 10 papers applied the point of initial admission into ICUs. The number and period of application of nursing intervention appeared to vary. The effect of the nursing inter-

vention was reported as delirium occurrence in the 11 papers, wherein the 6 papers employed the report of the length of ICU stay. The statistical significance of the rate of incidence of delirium was identified from 8 papers, while that of the length of stay of patients in ICU was identified from one paper.

Effect of Preventive Nursing Intervention for the Prevention of Delirium

Regarding the magnitude of the effect of nursing, the results of 10 non-RCT papers were employed for the meta-analyses. Since there were no significant differences, in terms of the magnitude of the effect and significance thereof, between the one RCT paper including 10 non-RCT papers and the results of no-RCT papers.

Effect of Preventive Nursing Intervention on delirium occurrence

The Peto OR of delirium occurrence appeared as 0.29 (95% CI=0.20~0.43) which was statistically significant (Z=6.23, P <.01) in both group. The heterogeneity of the magnitude of effect appeared low with the value of I²=12.0% (χ²=10.26, df=9, P=.33) (Fig. 2-A).

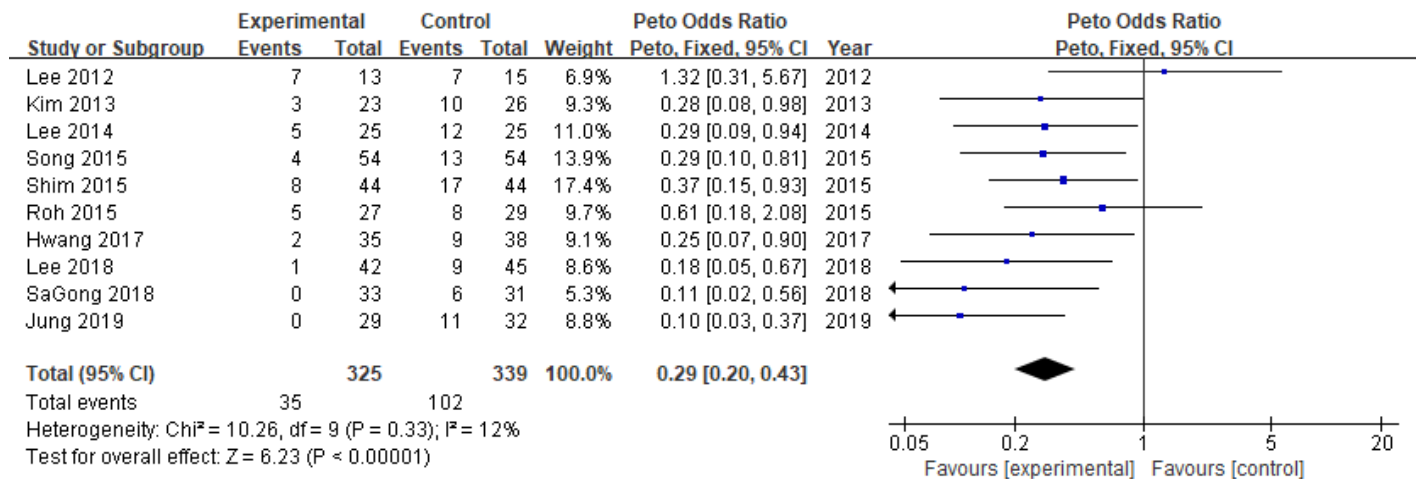


Fig. 2-A: Effect of delirium prevention program on delirium occurrence

Effect of Preventive Nursing Intervention on the Length of Stay of Patients in ICU

The magnitude of the effect for the length of stay of patients in ICUs demonstrated insignificant

values, $MD=-0.23$ (95% $CI=-0.51\sim0.05$) ($Z=1.60$, $P=.11$). Whereas the heterogeneity of the magnitude of the effect appeared low with a value of $I^2=49.0\%$ ($\chi^2=7.80$, $df=4$, $P=.10$) (Fig. 2-B).

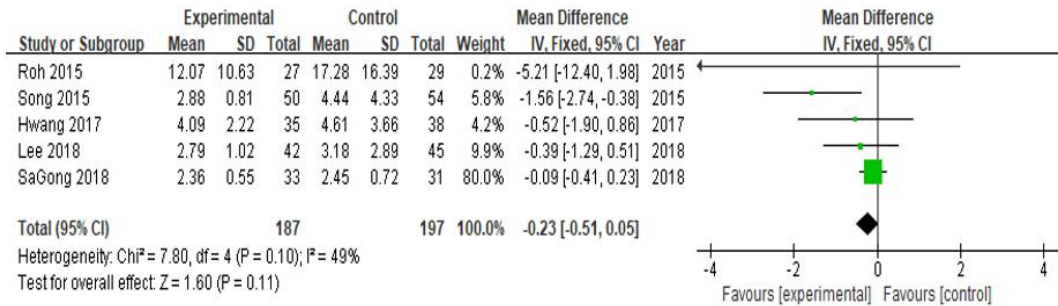


Fig. 2-B: Effect of delirium prevention program on the length of ICU days

Publication Bias

The publication bias of papers was examined through a visual funnel plot, wherein the publication bias appeared symmetrical against the inte-

grated estimates of meta-analyses for delirium occurrence by the nursing intervention, thereby the lower level of publication bias was estimated (Fig.3).

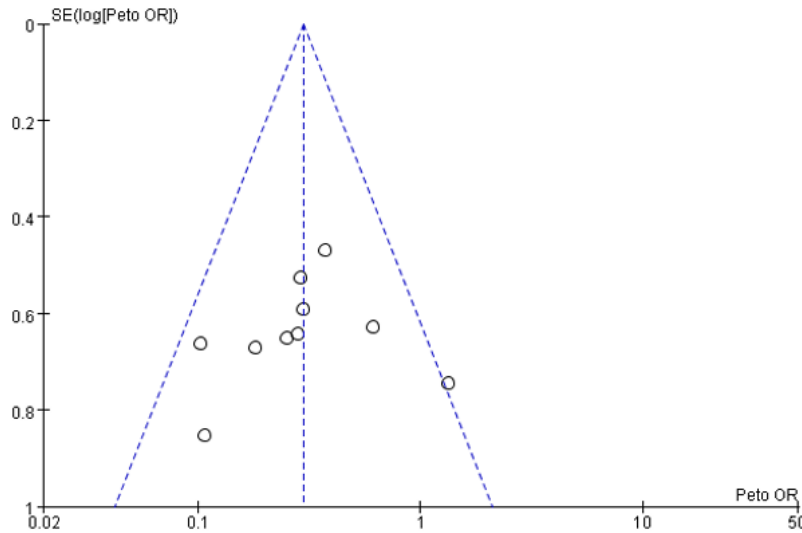


Fig. 3: Funnel plot of standard error by Peto odds ratio

Discussion

The design of 10 studies among 11 ones was non-RCT; the studies were distributed uniformly every year since 2012 when the studies began to be reported. The effects of the interventional nursing program were examined through systematic review based on which the interventional

program was distinguished into four categories wherein all the nursing interventions for the prevention of delirium appeared as the type of multi-component intervention. Except for the partial differences in the numbers of the type and kind of factors involved in the nursing intervention, the interventional strategies of nursing programs targeted the risk factors of creating delirium.

These corresponded to practical recommendations on guidelines for prevention and control of delirium specified in the ABCDEF bundle (15) and 2018 PADIS guidelines (8). However, the domains of treatment and assessment of pain, emphasized and newly included in the practical guidelines were found to be not included in the nursing intervention programs for the prevention of delirium.

The nursing intervention program for delirium was analyzed according to 8 protocols (25), wherein the protocols of visual- and hearing aids were commonly included in every nursing intervention while the orientation protocol and sleep enhancement protocol were included in 9 literatures, respectively; these were followed by the early mobilization, dehydration protocol, and cognitively stimulating protocol. Besides, the non-pharmacologic sleep protocol was mentioned only in the two literatures as components of the nursing intervention program for delirium. By referring to practical guidelines, the nursing intervention for the prevention of delirium was categorized as the type of intervention of composite factors, thus the addition of assessment and control of pain together with the participation of family members, as well as reflecting dehydration, cognitively stimulating activities, and non-pharmacologic sleep. In particular, the comprehensive preventive nursing intervention program, applicable to ICUs, needs to be prepared through an appraisal of care setting in ICUs and clinical characteristics and individual needs of inpatients in ICU, as recommended in the revised NICE delirium guidelines via developing the tailored multicomponent intervention package.

With regards to the effects of nursing intervention on prevention of delirium, the statistical significance of delirium occurrence was reported in 8 papers, and the length of ICU stay was reported in one paper. Overall, 35 preventive nursing interventions other than drug administration systematically were examined and conducted meta-analyses thereon (18), delirium occurrence was presented as a resulting variable from 33 cases, together with the duration of delirium, the length of ICU stay, and ICU mortality, presented as re-

sulting variables from part of the cases. Flannery et al. (26) reported the effects of sleep-promotion intervention for ICU-acquired delirium in terms of the incidence of ICU delirium, duration of delirium, and length of stay in ICU. Bannon et al. (17) also reported the effects of non-drug intervention for the prevention of delirium in diverse fields on the incidence and duration of delirium through systematic review and meta-analyses.

The CAM-ICU was found as mostly employed in the nursing intervention (81.8%) for the measurement of delirium occurrence in Korea among diverse kinds of tools designed for the assessment and diagnosis of delirium occurrence owing to the validity and reliability of the tool. Wassenaar et al. (27), who developed the prediction model of delirium occurrence in 24 h upon admission of inpatients in ICU, also employed the CAM-ICU solely for the screening of risk factors of delirium.

The meta-analysis on nursing intervention for the prevention of delirium in Korea revealed that it was effective in reducing delirium occurrence in ICUs than usual nursing intervention; however, it appeared as insignificant in reducing the length of ICU stays. Kang et al. (18) conducted the meta-analysis on the effects of non-drug preventive interventions for delirium, and revealed the sole presence of the effect of decreasing delirium occurrence by the multi-component intervention, and found no evidence of effects on the decrease in incidence rate from other kinds of interventions including the physical environment. Besides, the effects of the decrease in the incidence rate and duration of delirium from the multi-component intervention were also identified in the meta-analysis on the network of 26 non-drug interventions employed for the prevention of delirium, wherein the family participation also appeared effective in decreasing delirium occurrence (28). Since the multi-component strategies can be considered as ways of utilizing several interventions simultaneously, they can also be regarded as an ideal option for the prevention of ICU-acquired delirium. On the contrary, the systematic review and meta-analysis of the 7 RCTs studies that explored the delirium in 11 advanced

countries rendered no effects on delirium occurrence from a single preventive intervention as well as from all multi-component preventive interventions (17).

The nursing intervention for the prevention of ICU-acquired delirium in Korea rendered no effects on reducing the length of ICU stay. This was similar to the results of Kang et al. (18) that reported no total effects, as well as no sole effect of the multi-component intervention, on reducing the length of stay of inpatients in ICUs. In other words, the effect of preventive nursing intervention intending for the prevention of delirium was identified based on the results of the meta-analyses on 10 non-RCT studies, contrary to the study on RCT design conducted by Moon and Lee (29). In addition, the results of meta-analyses on non-RCTs, as well as the results of RCT conducted by Moon and Lee (29), also rendered no effects on decreasing length of ICU stay. The possibility of excessive effect due to the protocol design of the non-RCTs study cannot be excluded. Thus, by synthesizing the situation mixed with previous results of meta-analyses on RCTs and results obtained from this study, it is suggested that the studies on preventive nursing intervention for the prevention of delirium need to be promoted further together with more studies on the comparison between nursing interventions employing multi-components and single component.

Due to the following limitations included in this study, care should be taken for the generalization of estimations of meta-analyses. The number of papers employed for the meta-analysis was only 10 with the protocol design of each study of non-RCT, thereby there are definite limitations in the strength of foundation for making the judgment of such estimations. Besides, in relation to the fragility of protocol design of the study, portions of studies left indefinite descriptions on the severity or co-morbidity of inpatients in ICUs as well as factors associated with the treatment of respective (underlying) diseases of subjects. Moreover, most of the papers rendered indefinite descriptions on the major risk factors or control of confounding variables, etc. Thus, these limited

the confirmation of the effects of preventive nursing intervention on the delirium in Korea. Therefore, the efforts for the promotion and accumulation of results to be obtained from RCTs studies are needed to provide appropriate nursing intervention for the prevention of delirium.

Besides, there were plausible biases in the interpretation of results derived from the meta-analyses because the methods and types of incorporation of the provided nursing intervention with ordinary nursing practices, number of components in nursing intervention, the duration and intensity of nursing intervention, and the time point and frequency of assessment of results of the nursing intervention varied widely. Therefore, the standardization of assessment of the effects, delivery, and types of multi-component nursing intervention that fitted for nursing practice in ICUs in Korea, as well as the alternative nursing interventions to be realized through redesign of multi-component and customized differentiation, are needed in the future.

Conclusion

The nursing interventions prepared for the prevention of delirium in ICUs are based on risk factors generating delirium and types of multi-component nursing interventions comprising preventive strategies against delirium. In addition of assessment and control of pain and the expansion in the participation of family members in nursing intervention, as well as reflecting dehydration, cognitively stimulating activities, non-pharmacologic sleep protocol, etc. in the nursing intervention, are needed. In particular, the individual needs and clinical characteristics of individual patients in ICU, and the development of the tailored multi-component intervention packages, suitable for care settings in ICUs, need to be taken into account for the preparation of nursing intervention for the prevention of delirium applicable to nursing practices. Nonetheless, the generalization and interpretation of estimations obtained from meta-analyses conducted in this study are limited due to the research design

of studies employed for this study, degree of control on confounding variables owing to indefinite attributes of subjects' information, and the limitations in types, deliveries, and variability in the assessment of the nursing intervention.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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