MEDICAL SCIENCE

To Cite:
Alruhaimi NM, Al-amri NT, Almoteri MK, Almutairy AJ, Almutairi MO, Almutairi FA, Alotaibi AA, AlMutairi RA, ALOtibie SS, Alotibi NG. Association of nurse team level with patient outcome: Systematic review. *Medical Science* 2023; 27: e379ms3248
doi: https://doi.org/10.54905/disssi.v27i141.e379ms3248

Authors' Affiliation:
[1]Nurse, Wathailan General Hospital, Ministry of health, Saudi Arabia
[2]Nurse, Abha Psychiatric Hospital, Ministry of health, Saudi Arabia
[3]Nurse, Khalidiya Primary Health Care Center, Ministry of health, Saudi Arabia
[4]Nurse, Sajer General Hospital, Ministry of health, Saudi Arabia
[5]Nurse, Rafaya PHC, Ministry of health, Saudi Arabia

Peer-Review History
Received: 17 September 2023
Reviewed & Revised: 21/September/2023 to 07/November/2023
Accepted: 11 November 2023
Published: 18 November 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY
SCIENTIFIC SOCIETY

Association of nurse team level with patient outcome: Systematic review

Nagaa Mohammed Alruhaimi[1], Najla Thamer Al-amri[2], Masheri Kalaf Almoteri[1], Abdulaziz Julaimed Almutairy[1], Mohammed Omar Almutairi[1], Faten Aden Almutairi[3], Amani Ayedh Alotaibi[4], Rehab Awad AlMutairi[1], Samia Sultan ALOtibie[4], Nora Gasim Alotibi[5]

ABSTRACT

Numerous research has shown how registered nurses contribute to safe patient care. However, the majority of the data connecting staffing levels to results is cross-sectional and has inherent limitations, such as the inability to prove that the effect's putative cause (staffing) came first. In this investigation, we looked for and assessed the data from longitudinal studies demonstrating a link between nurse team levels, including the composition of the nursing team, and patient outcomes in ICU. We carefully analysed studies that used a longitudinal technique to assess the connection between nurse team level and patient outcomes. Studies imply repeated cross-sectional analyses were ignored unless a difference-in-difference approach was used. We searched Cochrane Library, CINAHL, Medline and Embase up until 2022. We combined the findings and organised them in a narrative and tabular fashion. Our findings further support the probable causal relationship between low registered nurse staffing and patient mortality provided by estimates of linkages from longitudinal research. In order to address residual uncertainty, future research should be conducted at numerous hospitals and report staffing numbers using standard measures.

Keywords: Nurse staff, nurse team level, patient outcome, systematic review

1. INTRODUCTION

Half of all healthcare workers globally are nurses, and the price of delivering inpatient hospital nursing services is one of the major cost factors for healthcare systems. To achieve cost-effective healthcare, nurse staffing levels must match patient demand. A costly input that can frequently be replaced by lower paid unregistered employees is how registered nurses perceived in the face of mounting financial demands and budgetary restrictions (Yakusheva et al., 2020). Registered nurses effectiveness and other nurses in

the workforce in delivering safe, high-quality care, including reducing deterioration, adverse outcomes like infections and pressure ulcers, and death among hospital inpatients. Along with registered nurses, other members of the nursing workforce include licenced practical nurses and nursing associates, who enter the field after completing a shorter training programme and, as a result, have a more limited scope of practise than registered nurses.

The breadth of the evidence is evident when examining the relationships between nurse staffing levels, the nursing workforce, and patient outcomes in inpatient hospital settings. Hundreds of studies have been published to date, and the majority of them support the finding that the higher the registered nurse staffing, the lower the rate of negative patient outcomes, such as death and infections (Griffiths et al., 2016). Numerous people have questioned whether additional research is necessary given the abundance of available evidence, which is conclusive and has clear consequences for practise and policy. According to past analyses, several of the studies in this literature are cross-sectional studies. Such studies cannot demonstrate that the staffing that the patients whose outcomes were measured, which is typically aggregated at the hospital level over a year, experienced corresponds to the observed variation in staffing levels and skill mix between hospitals, which is typically measured at the average hospital level. The purpose of this systematic review is to summarize the impact of patient outcomes in longitudinal studies that were exposed to variations in nurse staffing levels.

2. METHOD

According to our review procedure, since no research on this topic satisfied the requirements for inclusion, we decided to design the paper with a sole focus on nurse staffing.

Inclusion criteria

Studies must calculate how exposure to different levels or compositions of nursing personnel in a hospital inpatient unit (including intensive care units and normal wards) affects patients in order to be considered. Any indicator of the number of nurses on duty or the composition of the nursing staff was taken into account, including staff-to-patient ratios and staff hours per patient day. We considered case-control, cohort, retrospective, and prospective studies. Studies that clearly show that measurable variation in nurse staffing levels happened before the results and that there is a temporal relationship between nurse team level and patient outcomes are eligible. Except in cases where difference-in-difference designs were utilised to demonstrate a relationship between change in staffing and change in outcomes over time, studies with repeated measures that used a cross-sectional analysis were excluded. Although we did not predetermine a list of patient outcomes, we characterized patient outcomes as any results that patients themselves experienced as opposed to those that staff, families, and healthcare systems experienced.

Search strategy

Medline, CINAHL, Embase, and the Cochrane Library were all searched. Supplementary Material Table 1 contains the entire search plan. Searches were conducted through 2022.

Sample size

Of the 2089 items our search produced, 467 were duplicates, and 1321 were eliminated on the basis of the abstract and title. For eligibility, we read through all 301 of the remaining studies in their entirety. Eight eligible studies published between 2003 and 2021 were included in the review.

Review analysis

The initial screening was carried out by one reviewer to weed out duplicates and unrelated papers. Then, potential papers were further selected with a more thorough evaluation of their titles and abstracts. At this phase, each reviewer evaluated a sample of a study to check for consistency and to spot any areas where the selection criteria were unclear or ambiguous. After this screening, the complete texts of the studies that were still there were retrieved, and they underwent a thorough evaluation against the standards. All reviewers evaluated each full-text paper. To establish agreement among all reviewers, disagreements were handled through dialogue. We took the author, publication year, conclusions, nation, setting, sample size, staffing level metrics, and results from each included study.

3. RESULTS

Our search found 2089 results, of which 467 were duplicates and 1321 were removed based on title and abstract. We checked the complete text of the remaining 301 studies for eligibility. The review comprised 8 papers published between 2003 and 2021. Reasons for articles exclusion was demonstrated in (Figure 1). The majority of investigations were conducted at a single hospital, however there were notable exceptions. Hamilton et al., (2007) for example, comprised 54 hospitals. The number of patient samples varies from 692 Callaghan et al., (2003) to 146,349 (Rochefort et al., 2020). Four investigations were carried out in Intensive Care Units (ICUs), two in Acute Medical Units, and two in a variety of inpatient wards, which could include ICUs. Studies were carried out in the United Kingdom (n = 3), Canada (n = 2), the United States (n = 1), Australia (n = 1), and Switzerland (n = 1). Table 1 summarises the many methods used to assess nurse staffing levels.

Some studies imploy multiple staffing measures, such as the cumulative number of patient day per nurse hours throughout all stays and for only a portion of a patient admission days (e.g., the first two or five days of a patient admission days). Table 2 displays descriptive information about studies such as settings, designs, sample sizes, outcomes, and results. Some studies looked at averaged staffing levels or totaled cumulatively throughout the whole admission days, whereas others looked at staffing primarily in the early part of the admission days, spanning from the first day to the first seven admission days (Table 2). Most assessments of registered nurse staffing levels (5 in all) found that more staffing was related with lower mortality, while there was some variation.

Studies in favour of more staffing comprised larger samples in terms of wards and patients. According to six research Musy et al., (2021), Beltempo et al., (2018), Fogg et al., (2021), Griffiths et al., (2019), Needleman et al., (2020) and Rochefort et al., (2020) higher registered nurse staffing levels were linked to a lower risk of in-hospital mortality in adult general patient populations. Although the coefficients, when they were given, favoured higher registered nurse staffing, one analyses found relationships between registered nurse staffing levels and patient mortality that were not statistically significant (Hamilton et al., 2007). In a single ICU with 692 patients, an analysis indicated that higher registered nurse staffing levels were linked to a higher risk of mortality (Callaghan et al., 2003). Studies that examined the impact of nursing assistants or licenced practical nurses did so by concentrating on the staffing levels of these individuals or by taking the team's skill mix into account. Mixed results and an inconsistent picture with opposing conclusions are presented by the findings. Results are shown in (Table 2).

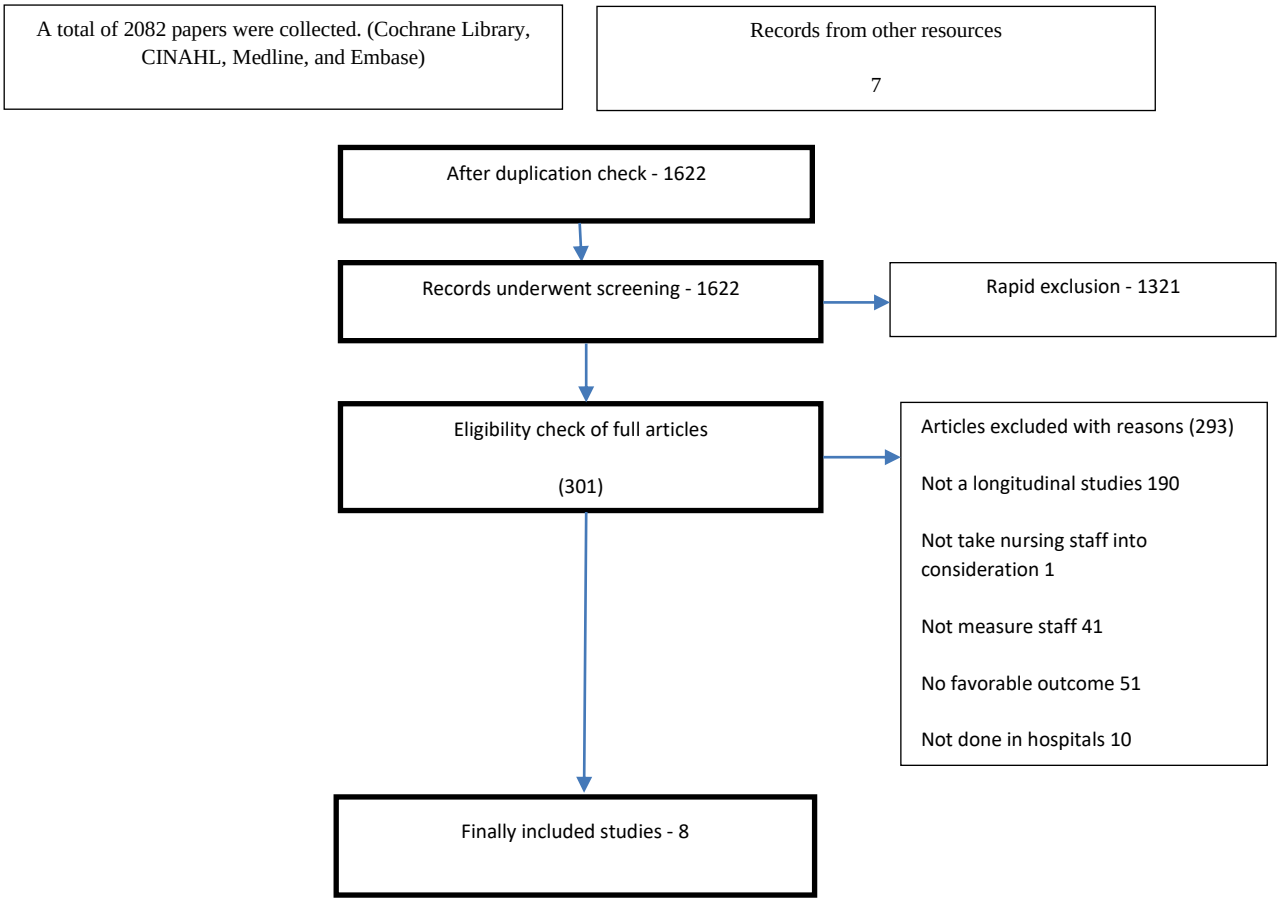

Figure 1 Selection consort chart

Table 1 The frequency with which personnel level and skill mix measures were employed in included research.

Staffing measure	Number	Authors
Staffing levels		
Studies that take into account absolute staffing levels		
Patient- nurse ratio	2	(Callaghan et al., 2003, Rochefort et al., 2020)
12-hour shift	1	(Needleman et al., 2020)
Nurses per shift	2	(Hamilton et al., 2007, Rochefort et al., 2020)
Studies conducted in relation to a predefined standard		
Days with a staffing level lower than the unit mean	1	(Griffiths et al., 2019)
Nurse Hours divided by number of required hours of care	1	(Beltempo et al., 2018)
50% above below median number of registered nurses expected	1	(Musy et al., 2021)

Table 2 Selected study characteristics

Study author and publication year	Sample size	Study design	Study setting and country	Staff measure	Group of nurse staff	Outcome	Results
Musy et al., 2021	A total of 3646 nurses and 79,893 data points from 55 units were examined.	Observational study	Adult hospital; Switzerland	50% high low staffing	Licenced Practical Nurse	In hospital mortality	High low staffing OR 0.91 0.95 CI -89% to 93%
Needleman et al., 2020	78,303	Observational study	Tertiary medical Centre in USA	Low nurse hours per patient per shift percentage of shifts.	Registered Nurse plus Nursing Assistant	In hospital mortality	Hazard Ratio 1.04, 0.95 CI = 99% to 110%
Rochefort et al., 2020	146,349	Observational study	Surgical unit, medical unit and ICU in adult hospital in Canada	Shift lower or equal to 8 hours	Registered Nurse	In hospital mortality	Hazard Ratio 1.01, 0.95 CI = 1.0 to 1.01
Fogg et al., 2021	Patient 9643	Retrospective study	Medical and surgical units of general hospital in United Kingdom	Relative to the average registered nurse patient day per nurse hours (using non-linear parameters)	Nursing Assistant	30 days discharge and in hospital mortality	OR 0.90; 95% CI 0.84 to 0.97
Griffiths et al., 2019	Patients 138133 Registered nurse 1244	Retrospective study	Medical and surgical units of general hospital in United Kingdom	comparable to the average, registered nurse hours per patient day	Nursing Assistant	In hospital mortality	HR 0.97; and 95% CI 0.94 to 0.99
Hamilton et al., 2007	Patients 2585	Cohort study	Neonatal ICU in United Kingdom	dividing the number of recommended specialist nurses per shift by the number of available specialist nurses	Registered Nurse	Prior to discharge and anticipated home deaths	OR 0.63; 95% CI 0.42 to 0.96
Beltempo et al., 2018	2236 patients Nurses 165 In one hospital	Case control	Neonatal ICU; Canada	Total nurse hours worked divided by total hours of care required based on patient dependency categories	Registered Nurse	Death or serious morbidity	RR 0.81; 95% CI 0.74 to 0.90
Callaghan et al., 2003	Patients 692	Cohort study	Neonatal ICU; Australia	1.71-1.97 patient-to-nurse ratio	Registered Nurse	In hospital mortality	OR 0.18, 95% CI 0.06 to 0.5

Abbreviations; OR Odds Ratio; RR Risk Ratio; Statistically significant at less than 0.05; HR Hazard Ratio; CI Confidence Interval.

4. DISCUSSION

This comprehensive analysis of longitudinal studies looked at the impact of nurse staffing levels on patient outcomes. These studies can show a temporal relationship between staffing exposure and results, overcoming a fundamental drawback of the bulk of cross-sectional studies in this topic. The findings are consistent with lower registered nurse staffing reducing the probability of patient death, even though studies were done across distinct samples, using various staffing measures and exposure windows. While evidence indicate that harm associated with high levels of assistant staffing and temporary personnel, the data regarding the positive contribution of other staff groups and changes to the skill mix of the nursing team is much more conflicted. This data supports results drawn mostly from cross-sectional data Griffiths et al., (2016), however cause must come before effect when evaluating the requirements for establishing a causal association.

The data examined here is observational, but if pertinent confounders are taken into account throughout the analysis, the parameter estimates for exposure may be interpreted causally Hernán, (2018), but some bias risk still exists. Additionally, the relationship between low staffing and in hospital mortality has been theorized and experimentally proven, with a failure to notice and respond to deterioration serving as a major mediating factor (Redfern et al., 2019; Smith et al., 2020; Griffiths et al., 2019). It is challenging to draw definite conclusions regarding the size of effects beyond the estimates offered by individual research due to the variety of settings and patient demographics, as well as the lengthy period of time studies were published (2003–2021). Although the measured effect sizes for mortality are often tiny, these effects are nonetheless significant due to the huge populations at risk.

One hour increase of registered nurse per patient day over three years was predicted to prevent more than 650 deaths and save about 30,000 admission beds through shorter admission duration in a study that included more than 138,000 medical plus surgical admissions to one tertiary hospital with about 800 beds (Griffiths et al., 2019). It is more difficult to draw a broad conclusion and infer a causal relationship from these data when nursing assistants and other grades of nursing personnel are taken into account because the effects found are mixed. The evidence suggests that any causal relationship is complex, with non-linear effects hinting at competing causal pathways from increasing resources (good) as opposed to the replacement of registered nurses (Griffiths et al., 2019; Musy et al., 2021).

5. CONCLUSION

The evidence under evaluation is still observational and may be biassed in effect estimates, although a few studies with minimal bias risk offer strong evidence in favour of a causal interpretation of the results. In acute care settings, higher registered nurse staffing levels reduce the risk of patient death, yet it is challenging to produce generalizable estimates of effect due to the small number of studies with minimal risk of bias.

Ethical consent

Not applicable

Authors contribution

Nagaa Mohammed Alruhaimi: Participated in all steps of research starting from research idea to submission; Najla Thamer Al-amri, Masheri Kalaf Almoteri, Abdulaziz Julaimed Almutairy, Mohammed Omar Almutairi, Faten Aden Almutairi, Amani Ayedh Alotaibi, Rehab Awad AlMutairi, Samia Sultan ALOtibie, Nora Gasim Alotibi: Participated in collecting literature and analyzing full article as well as writing introduction method and discussion.

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Beltempo M, Lacroix G, Cabot M, Blais R, Piedboeuf B. Association of nursing overtime, nurse staffing and unit occupancy with medical incidents and outcomes of very preterm infants. J Perinatol 2018; 38(2):175-180. doi: 10.1038/jp.2017.146
2. Callaghan LA, Cartwright DW, O'Rourke P, Davies MW. Infant to staff ratios and risk of mortality in very low birthweight infants. Arch Dis Child Fetal Neonatal Ed 2003; 88(2):F94-7. doi: 10.1136/fn.88.2.f94
3. Fogg C, Bridges J, Meredith P, Spice C, Field L, Culliford D, Griffiths P. The association between ward staffing levels, mortality and hospital readmission in older hospitalised adults, according to presence of cognitive impairment: a retrospective cohort study. Age Ageing 2021; 50(2):431-439. doi: 10.1093/ageing/afaa133
4. Griffiths P, Ball J, Drennan J, Dall'Ora C, Jones J, Maruotti A, Pope C, Recio Saucedo A, Simon M. Nurse staffing and patient outcomes: Strengths and limitations of the evidence to inform policy and practice. A review and discussion paper based on evidence reviewed for the National Institute for Health and Care Excellence Safe Staffing guideline development. Int J Nurs Stud 2016; 63:213-225. doi: 10.1016/j.ijnurstu.2016.03.012
5. Griffiths P, Maruotti A, Recio-Saucedo A, Redfern OC, Ball JE, Briggs J, Dall'Ora C, Schmidt PE, Smith GB; Missed Care Study Group. Nurse staffing, nursing assistants and hospital mortality: retrospective longitudinal cohort study. BMJ Qual Saf 2019; 28(8):609-617. doi: 10.1136/bmjqs-2018-008043
6. Hamilton KE, Redshaw ME, Tarnow-Mordi W. Nurse staffing in relation to risk-adjusted mortality in neonatal care. Arch Dis Child Fetal Neonatal Ed 2007; 92(2):F99-F103. doi: 10.1136/adc.2006.102988
7. Hernán MA. The C-Word: Scientific Euphemisms Do Not Improve Causal Inference from Observational Data. Am J Public Health 2018; 108(5):616-619. doi: 10.2105/AJPH.2018.304337
8. Musy SN, Endrich O, Leichtle AB, Griffiths P, Nakas CT, Simon M. The association between nurse staffing and inpatient mortality: A shift-level retrospective longitudinal study. Int J Nurs Stud 2021; 120:103950. doi: 10.1016/j.ijnurstu.2021.103950
9. Needleman J, Liu J, Shang J, Larson EL, Stone PW. Association of registered nurse and nursing support staffing with inpatient hospital mortality. BMJ Qual Saf 2020; 29(1):10-18. doi: 10.1136/bmjqs-2018-009219
10. Redfern OC, Griffiths P, Maruotti A, Recio-Saucedo A, Smith GB; Missed Care Study Group. The association between nurse staffing levels and the timeliness of vital signs monitoring: a retrospective observational study in the UK. BMJ Open 2019; 9(9):e032157. doi: 10.1136/bmjopen-2019-032157
11. Rochefort CM, Beauchamp ME, Audet LA, Abrahamowicz M, Bourgault P. Associations of 4 Nurse Staffing Practices With Hospital Mortality. Med Care 2020; 58(10):912-918. doi: 10.1097/MLR.0000000000001397
12. Smith GB, Redfern O, Maruotti A, Recio-Saucedo A, Griffiths P; The Missed Care Study Group. The association between nurse staffing levels and a failure to respond to patients with deranged physiology: A retrospective observational study in the UK. Resuscitation 2020; 149:202-208. doi: 10.1016/j.resuscitation.2020.01.001
13. Yakusheva O, Rambur B, Buerhaus PI. Value-Informed Nursing Practice Can Help Reset the Hospital-Nurse Relationship. JAMA Health Forum 2020; 1(8):e200931. doi: 10.1001/jamahealthforum.2020.0931