

Evaluating Ratio of Mortality and Failure to Rescue Between Magnet and Non-Magnet Hospitals: A Meta- Analysis

Magnet ve Magnet Olmayan Hastaneler Arasında Ölüm ve Kurtarma Başarısızlığı Oranlarının İncelenmesi: Bir Meta Analiz Çalışması

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Abstract

Aim: This meta-analysis aimed to quantify differences in mortality and failure-to-rescue (FTR) between Magnet and non-Magnet hospitals.

Methods: A literature review was carried out covering studies published from 2000 to 2018 using keywords related to magnet hospitals, non-magnet hospitals, mortality, and FTR. Seven studies involving approximately 4.5 million patients met the inclusion criteria. Data were analyzed using the CMA software, calculating odds ratios (OR) under a random-effects model. Heterogeneity was assessed using Cochran's Q and I² statistics. Publication bias was evaluated using funnel plots and statistical analysis.

Results: Compared with non-Magnet hospitals, Magnet hospitals showed 15% lower odds of mortality (OR = 0.85, 95% CI: 0.796–0.907, p <0.001) and 6% lower odds of FTR (OR = 0.94, 95% CI: 0.889–0.997, p = 0.038). Significant heterogeneity was observed, mainly attributed to differences in the data collection periods, with long-term studies demonstrating more pronounced effects. No publication bias was observed.

Conclusion: Magnet hospital designation is associated with significantly reduced mortality and FTR rates, reflecting superior nursing environment and care quality.

Key Words: Magnet hospitals, non-magnet hospitals, mortality, failure to rescue, meta-analysis

Özet

Amaç: Bu meta-analiz, Magnet hastaneler ile Magnet olmayan hastaneler arasındaki ölüm ve kurtarma başarısızlığı (FTR) oranlarını nicelleştirmeyi amaçlamıştır.

Yöntem: Magnet hastaneler, magnet olmayan hastaneler, ölüm oranı ve FTR ile ilgili anahtar kelimeler kullanılarak 2000 ile 2018 yılları arasında yayınlanan çalışmalar için bir literatür taraması yapılmıştır. Yaklaşık 4,5 milyon hastayı içeren yedi çalışma dahil etme kriterlerini karşılamıştır. Veriler, rastgele etkiler modeli altında olasılık oranları (OR) hesaplanarak Comprehensive Meta Analysis (CMA) yazılımı kullanılarak analiz edilmiştir. Heterojenite, Cochran'ın Q ve I² istatistikleri kullanılarak değerlendirilmiştir. Yayın yanlılığı, huni grafikleri ve istatistiksel analiz kullanılarak değerlendirilmiştir.

Bulgular: Magnet hastaneler, magnet olmayan hastanelerle karşılaştırıldığında; magnet hastanelerde ölüm oranlarında %15 daha düşük (OR = 0,85, %95 CI: 0,796–0,907, p <0,001) ve FTR oranlarında %6 daha düşük olasılık oranı (OR = 0,94, %95 CI: 0,889–0,997, p = 0,038) olduğu görülmüştür. Veri toplama dönemlerindeki farklılıklara bağlı olarak önemli heterojenite gözlemlenmiş olup, uzun süreli çalışmalar daha belirgin etkiler göstermiştir. Yayın yanlılığı gözlemlenmemiştir.

Sonuç: Magnet hastane statüsü, üstün hemşirelik ortamı ve bakım kalitesini yansıtan, önemli ölçüde azalmış ölüm ve FTR oranlarıyla ilişkilidir.

Anahtar Kelimeler: Magnet hastane, magnet olmayan hastane, ölüm oranı, kurtarma başarısızlığı, meta analiz

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1. Giriş / Introduction

Magnet hospitals are recognized as institutions that provide high-quality patient care, demonstrate excellent nursing practices, and retain qualified nurses, resulting in improved patient outcomes and evidence-based practices (1-6). These hospitals distinguish themselves by fostering positive work environments characterized by reduced hierarchical barriers, participatory management, high nurse autonomy, investment in staff education, effective nurse-physician collaboration, and strong nursing leadership (2,4,7-9). Consequently, nurses in magnet hospitals report higher job satisfaction, lower burnout, and reduced turnover intentions than those in non-magnet institutions (6,10-13).

Patient outcomes in magnet hospitals also tend to be superior, with evidence of lower mortality rates, reduced failure-to-rescue incidents, decreased patient fall rates, and higher patient satisfaction levels (14-19). The concept of magnet hospitals originated in the early 1980s in the United States to address nursing shortages by identifying hospitals that successfully attracted and retained professional nurses through supportive organizational characteristics (20,21). In 1994, the American Nurses Credentialing Center (ANCC) established the Magnet Recognition Program to recognize hospitals that exhibit high standards of nursing practice (21,22).

Despite the global proliferation of magnet hospitals (exceeding 500 institutions worldwide), Türkiye has yet to have a magnet-designated hospital. Studies adapting magnet standards to the Turkish healthcare context indicate that while some criteria are met, Turkish hospitals have not yet fully realized overall magnet characteristics (23-25). Ongoing health transformation policies in Türkiye have addressed nurse staffing shortages; however, quality care depends on more than staffing levels alone, highlighting the need for organizational changes aligned with magnet principles.

Given the increasing emphasis on magnet designation to improve nursing management, autonomy, professional development, and patient care quality, it is crucial to systematically evaluate the impact of magnet status on key patient outcomes,

such as mortality and failure to rescue. Although numerous studies have investigated these outcomes individually, there is a lack of comprehensive meta-analytic evidence comparing magnet and non-magnet hospitals on these variables. This study aims to fill this gap by synthesizing existing research through a meta-analysis to provide robust evidence of the effect of magnet hospital status on mortality and FTR rates.

2. Yöntem / Method

This meta-analysis aimed to evaluate overall effect sizes for mortality and FTR rates across Magnet and non-Magnet hospitals. The research question addressed was: What are the effect sizes of mortality and FTR rates between Magnet and non-Magnet hospitals?

2.1. Search Strategy

Relevant studies were systematically identified using the keywords “magnet hospital/s,” “non-magnet hospital/s,” “patient outcomes,” “mortality,” and “failure to rescue”. The final search strategy using storage-related keywords is fully detailed in Supplementary Table 1. Owing to the absence of relevant domestic studies, international literature was searched via the WOS, CINAHL, and ProQuest Dissertations and Theses Global databases for publications between January 1, 2000, and December 31, 2018. Both published and unpublished theses, articles, and conference proceedings were screened for eligibility.

Study selection was guided by the PICOS framework (Population, Intervention, Comparison, Outcomes, Study Design). Eligible studies met the following inclusion criteria: (P) hospitalized patient populations; (I) Magnet hospitals; (C) non-Magnet hospitals; (O) clinical outcomes encompassing mortality and/or failure to rescue; and (S) quantitative study designs published in English that provided sufficient statistical metrics (e.g., sample sizes, odds ratios [ORs], t-values, p-values, or percentages) to calculate effect sizes. The exclusion criteria included studies unrelated to Magnet status, those not addressing mortality or FTR, abstracts, editorials, non-English publications, and studies lacking analyzable data.

The reporting of this review follows the PRISMA statement guidelines (26). From 2,038 identified records (1,175 articles and 863 theses), seven studies were included after removing duplicates and applying the criteria. The PRISMA flowchart outlines the process used for study selection (Figure 1).

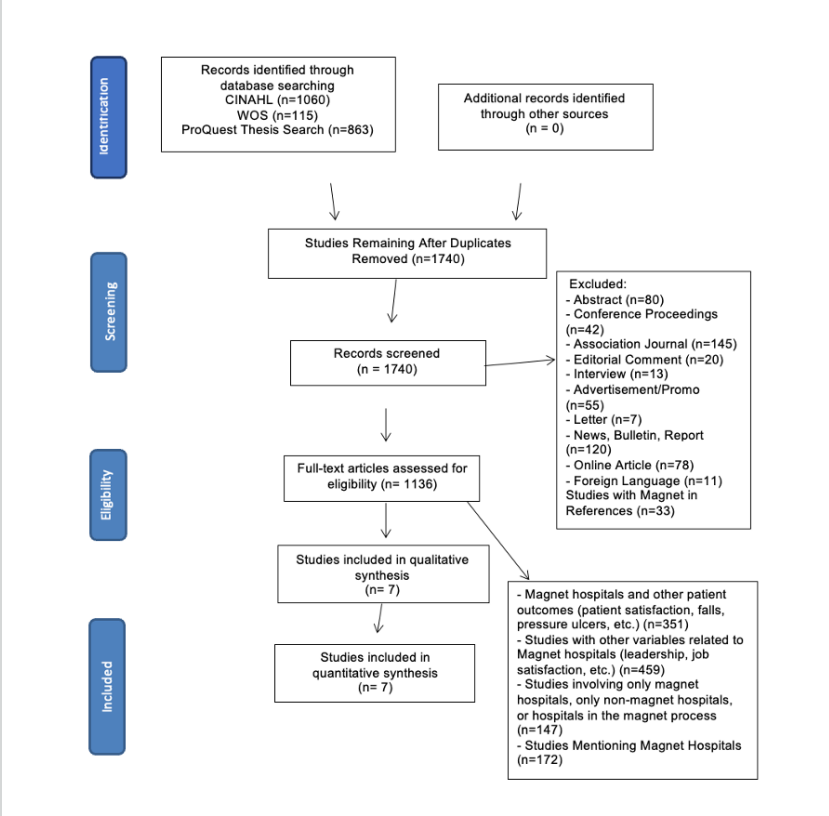


Figure 1. PRISMA flow diagram of study selection

2.2. Ethical Consideration

As this study involved a meta-analysis of existing literature without direct human or animal subjects, ethical approval was not required.

2.3. Data Analysis

A coding protocol was developed to ensure validity and reliability. Data extraction was performed by one study author alongside an independent meta-analysis expert. Inter-rater agreement was assessed using Cohen’s kappa coefficient ($\kappa=0.837$), indicating excellent reliability (27). This dual-independent extraction framework confirmed the validity of the

study selection process (28). Additionally, because the data collection tools in all seven included studies were validated and reliable, this meta-analysis’s overall validity was further substantiated. Methodological quality of the eligible studies was evaluated using the Joanna Briggs Institute Statistical Analysis Review and Evaluation Tool (JBI-MAStARI) for observational studies. This 9-item checklist awards one point for each ‘yes’ answer, whereas ‘no,’ ‘unclear,’ and ‘not applicable’ options receive zero points. Overall scores span from 0 to 9, with higher scores reflecting study quality (29). Data were analyzed using Comprehensive Meta Analysis version 3 (CMA v.3). Heterogeneity was

evaluated using Cochran’s Q test and I² statistics. Cochran’s Q values exceeding degrees of freedom and p-values <0.05 indicated significant heterogeneity (30,31). I² values were interpreted as <30% (low), 30–75% (moderate), and >75% (substantial) heterogeneity (32). Magnet hospitals were designated as the experimental group and non-Magnet hospitals as the control group. Odds ratios (OR) were calculated to measure effect sizes by comparing the two groups. In this study, a magnet hospital was designated as the experimental group, while a non-magnet hospital served as the control group. Consequently, a positive calculated effect size was interpreted as favoring the magnet hospital, whereas a negative effect size was interpreted as favoring the non-magnet hospital. Publication bias was assessed using funnel plots, Egger’s regression intercept, and Begg and Mazumdar’s rank correlation tests. Subgroup

analyses were conducted to identify the sources of heterogeneity, examining the data collection tools, time intervals, and diagnosis types. A random-effects model was employed to synthesize effect sizes, driven by the results of statistical heterogeneity testing.

3. Bulgular/Results

Two reviewers independently evaluated the methodological quality of the eligible studies using the JBI-MAStARI appraisal tool. The two independent reviewers found no discrepancies during the quality appraisal. As a result of the appraisal, quality scores ranged from 4 to 7 points. Due to the absence of a validated cutoff value and the scarcity of eligible studies, all appraised studies were included in the review (Table 1).

Tablo 1. Methodological quality evaluation of studies

Studies	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total Score
Bekelis et al. (2017)	N	Y	N/A	Y	Y	Y	N/A	Y	Y	6
Evans et al. (2014)	N	Y	Y	Y	Y	N/A	U	Y	Y	6
Kutney-Lee et al. (2015)	N	N	N/A	Y	Y	Y	N/A	Y	U	4
Friese et al. (2015)	N	N	N/A	Y	Y	Y	N/A	Y	U	4
McHugh et al. (2013)	N	Y	Y	Y	Y	N/A	U	Y	Y	6
Missios & Bekelis (2018)	N	Y	N/A	Y	Y	Y	N/A	Y	Y	6
Mills & Gillespie (2005)	Y	Y	N	Y	Y	Y	Y	Y	N	7

Y: Yes, N: No, Unclear: U, N/A: Not Applicable

The meta-analysis included seven studies examining mortality rates and five studies examining FTR rates. Among these, Kutney-Lee et al. (2015) provided data for two different time points and were analyzed as two separate studies (a and b). The total sample size across all the included studies was approximately 4,471,182 patients. All analyzed studies were based in the United States, and their designs ranged from retrospective cohort studies to multivariable regression models. Data were generally obtained using national or standardized data collection tools, such as ICD-9 CM codes, the Elixhauser comorbidity

index, and TPM (Trauma Mortality Prediction Model). Bekelis et al. (2017) examined mortality rates for 2009–2013; Evans et al. (2014) for 2009–2011; Friese et al. (2015) analyzed mortality and failure-to-rescue rates for 1998–2010; Kutney-Lee et al. (2015a) for 1999 and (2015b) for 2006; McHugh et al. (2013) for 2006–2007; Missios and Bekelis (2018) for 2009–2013; Mills (2013) evaluated failure-to-rescue rates for 2001–2005. The results of the studies included in the review indicate that Magnet hospitals generally have a positive effect on both mortality and FTR rates. In terms of mortality rates, the risk

of death was found to be 24% lower in patients with acute ischemic stroke treated at Magnet hospitals (33), 17% lower in trauma patients (34), 20% lower in surgical cases (18), and 8% lower in neurosurgery patients (35). Friese et al. (2015) also reported a 7.7% reduction in 30-day mortality (15). When examining time-dependent changes, Magnet status did not show a significant difference in mortality rates in 1999, whereas by 2006, Magnet hospitals showed a significant advantage (16) (Table 2).

In terms of FTR rates, while McHugh et al. (2013) reported a 19% and Friese et al. (2015) a 9% reduction, demonstrating that Magnet status improves surgical outcomes, analyses by Kutney-Lee et al. (2015) and Mills and Gillespie (2013) found no statistically significant difference in FTR rates between the hospitals (Table 3).

Table 2. Study characteristics and main findings of mortality rate

Authors	Data collection tool	Time interval*	Disease diagnosis count**	Method	Sample Size (N)		Statistical Analysis Adjusted differences (%95 CI) and p-value	Interpretation
					Magnet hospital	Non-Magnet hospital		
Bekelis et al.	ICD-9 CM	2009-2013	Patients diagnosed with acute ischemia	Multivariable regression modeling	32 092	144 465	-%23,9 (-%18,7- %29,0) p<0,001	The mortality rate in stroke patients treated at Magnet hospitals is 24% lower.
Evans et al.	TMPM and ISS	2009-2011	Trauma patients	Logistic Regression Analysis	30 831	42 999	0,83 (0,70-0,99) p =0,033	The mortality rate among trauma patients in Magnet hospitals was found to be 17% lower.
Kutney-Lee et al. (a)	Elixhauser comorbidity index scale	1999	Mixed surgical patients	Retrospective study	38 783	194 868	Magnet= 2,44 Non-magnet= 2,56 p=0,52	There is no significant difference in mortality rates between Magnet and non-magnet hospitals.
Kutney-Lee et al. (b)	Elixhauser comorbidity index scale	2006	Mixed surgical patients	Retrospective study	48 200	209 956	Magnet= 1,28 Non-magnet= 1,51 p=0,05	Mortality rates are lower in Magnet hospitals.
Friese et al.	Elixhauser comorbidity index scale	1998-2010	Mixed surgical patients	Multivariable Analysis	839 802	1 057 212	% 7,7 (0,89-0,96)	Within 30 days, the mortality rate in Magnet hospitals was found to be 7.7% lower compared to non-magnet hospitals.
McHugh et al.	Elixhauser comorbidity index scale	2006-2007	Mixed surgical patients	Logistic regression modeling	109 090	532 097	0,80 (0,71–0,89) p<0,001	The mortality rate of surgical patients in Magnet hospitals is 20% lower.
Missios & Bekelis	ICD-9 CM	2009-2013	Neurosurgical patients	Multivariable regression modeling	68 046	122 741	-%0,8 (-%0,7- %0,6) p<0,001	The mortality rate in stroke patients treated at Magnet hospitals is 8% lower.

ICD-9 CM (International Classification of Diseases, 9th Revision Codes), TMPM (Trauma Mortality Prediction Model), ISS (Injury Severity Score)

* time interval; defined as short-term and long-term

**disease diagnosis count; defined as single and multiple diseases

Table 3. Study characteristics and main findings of FTR

Authors	Data collection tool	Time interval	Method	Sample Size (N)		Statistical Analysis Adjusted differences (%95 CI) and p-value	Interpretation
				Magnet hospital	Non-Magnet hospital		
Kutney-Lee et al. (a)	Elixhauser comorbidity index scale	1999	Retrospective study	38 783	194 868	Magnet= 6,82 Non-magnet= 6,77 p=0,93	There is no significant difference in FTR prevalence rates between Magnet and non-magnet hospitals.
Kutney-Lee et al. (b)	Elixhauser comorbidity index scale	2006	Retrospective study	48 200	209 956	Magnet= 4,04 Non-magnet= 4,43 p=0,21	There is no significant difference in FTR prevalence rates between Magnet and non-magnet hospitals.
Friese et al.	Elixhauser comorbidity index scale	1998-2010	Multivariable Analysis	236 213	432 945	% 8,6 (0,88-0,95)	The FTR rate was found to be 9% lower in Magnet hospitals
McHugh et al.	Elixhauser comorbidity index scale	2006-2007	Logistic regression modeling	839 802	1 057 212	0,81 (0,72–0,91) p<0,001	The FTR rate in surgical patients was found to be statistically significantly 19% lower in Magnet hospitals.
Mills & Gillespie	N/A	2001-2005	Retrospective study	80*	80*	Magnet= 11,89 Non-magnet= 12,06 t=0,299; p=0,765	There is no significant difference in FTR incidence rates between Magnet and non-magnet hospitals.

N/A: Not Applicable
* number of hospitals. The patient count is over 1,000,000.

For mortality rate, publication bias assessments including funnel plots, Rosenthal’s fail-safe N (481), Orwin’s fail-safe N (439), Begg and Mazumdar rank correlation ($p = 0.65230$), Egger’s regression test ($p > 0.05$), and Duval and Tweedie’s trim and fill method indicated no significant publication bias (Figure 2). The forest plot revealed that Friese et al. (2015) had the greatest weight (51%), while Missios and Bekelis (2018) had the least (0.4%). The pooled OR for mortality under the random-effects model was 0.85 (95% CI: 0.796–0.907, $p < 0.001$), indicating a 15% lower likelihood of mortality in Magnet hospitals relative to non-Magnet hospitals

(Table 4). Heterogeneity tests showed significant heterogeneity among studies ($Q=220.392$, $df=6$, $p < 0.001$; $I^2=97.3\%$), justifying the use of the random-effects model (Supplementary Table 2). Subgroup analyses revealed that heterogeneity was significantly influenced by the data collection period ($QB=15.477$, $df=1$, $p < 0.001$), with long-term studies showing a more pronounced reduction in mortality (OR=0.768, 95% CI: 0.678–0.870; $p < 0.001$) than short-term studies (OR=0.987, $p=0.060$). No statistically significant differences were observed by diagnosis type or data collection tool (Supplementary Table 3).

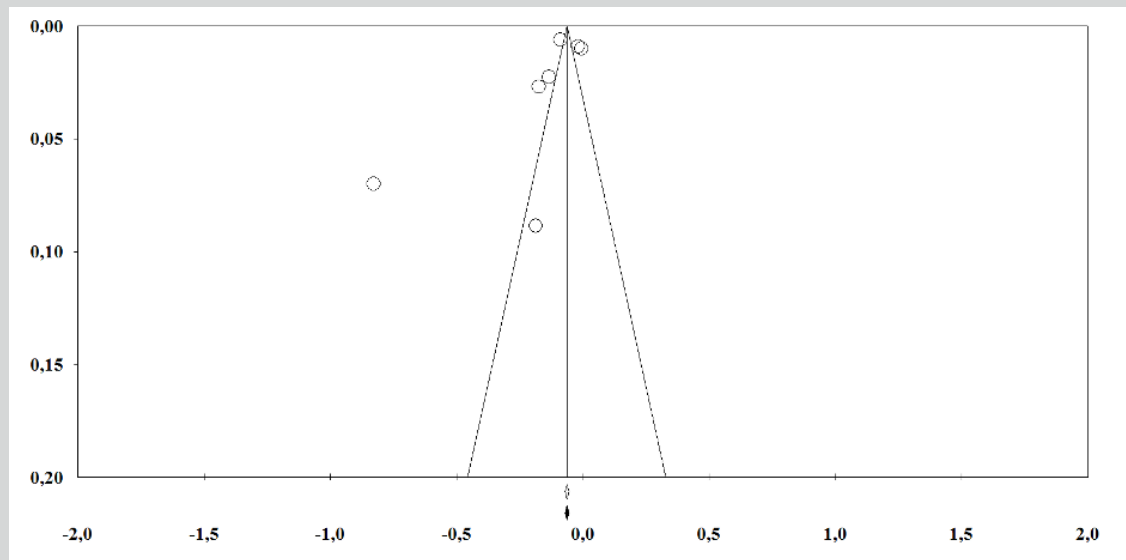
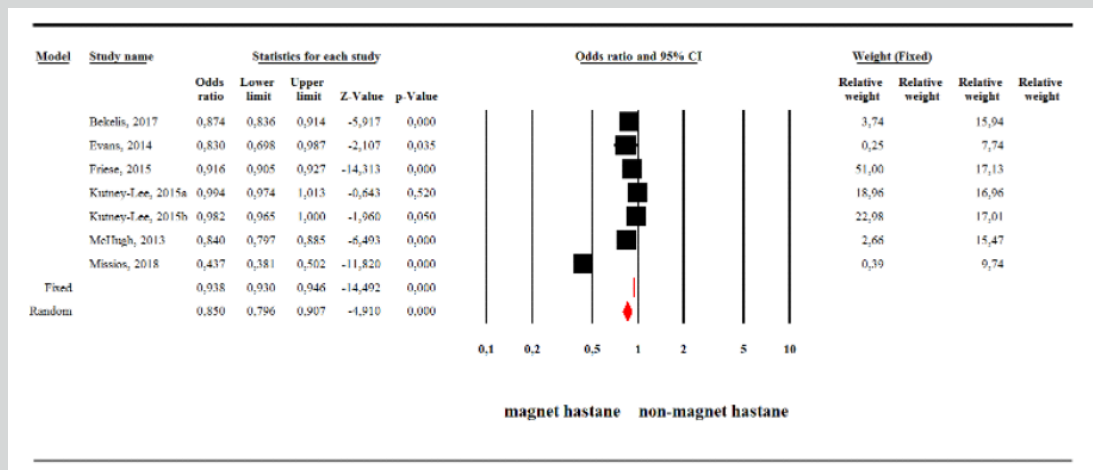


Figure 2. Funnel plot for mortality rate

Table 4. Forest plot of pooled odds ratios for mortality rate



Publication bias analyses for FTR also showed no evidence of bias (Rosenthal’s fail-safe N=87; Orwin’s fail-safe N=230; Begg and Mazumdar p=0.62421; Egger’s test p >0.05; trim and fill, zero studies imputed) (Figure 3). The pooled OR for FTR under the random-effects model was 0.94 (95% CI: 0.889–0.997; p =0.038), indicating a 6% lower likelihood of failure-to-rescue in Magnet hospitals relative to non-

Magnet hospitals (Table 5). Significant heterogeneity was observed (Q=87.245, df=4, p <0.001; I²=95.4%) (Supplementary Table 4). Subgroup analysis by data collection duration showed that long-term studies had a significant reduction in FTR (OR=0.892, 95% CI: 0.853–0.933; p <0.001), whereas short-term studies did not show significant differences (OR=0.994, p=0.385) (Supplementary Table 5).

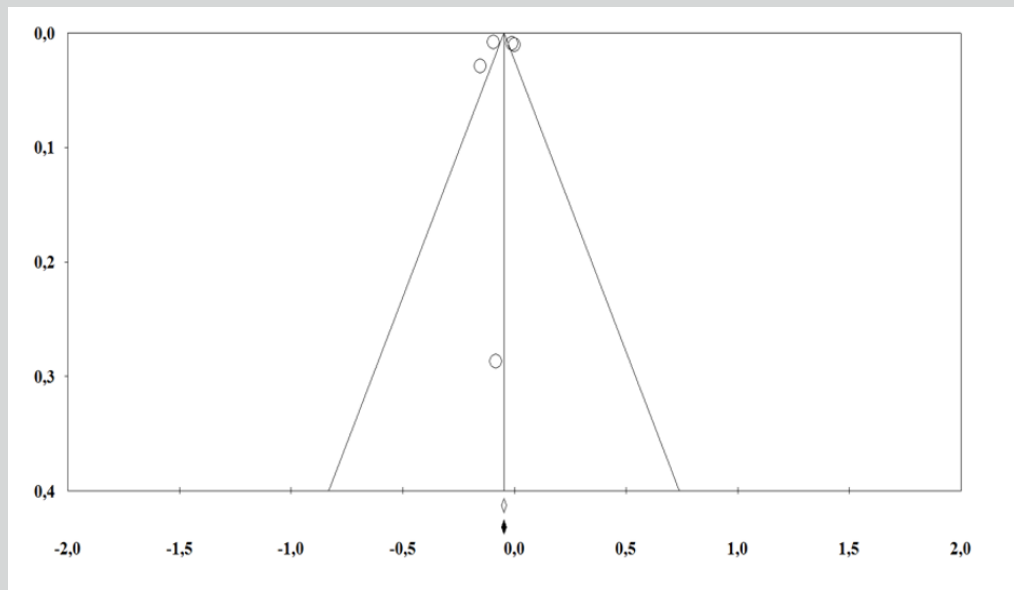
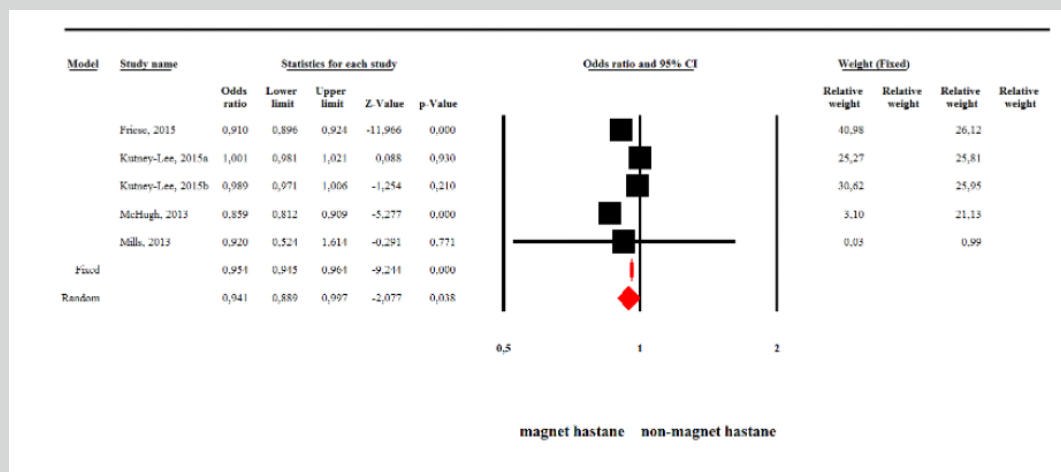


Figure 3. Funnel plot for FTR

Table 5. Forest plot of pooled odds ratios for FTR



1. Tartışma/Discussion

Mortality and failure-to-rescue rates in Magnet and non-Magnet hospitals were examined through a meta-analysis. The meta-analysis found that mortality rates and failure-to-rescue rates were 15% and 6% lower, respectively, in Magnet hospitals than in non-

Magnet hospitals. Magnet designation significantly mitigates patient mortality risks. As a key indicator of institutional healthcare quality, lower mortality rates reflect the high standards maintained across Magnet institutions (14-16,19,33-35). In a scoping review by Connor et al. (37), Magnet hospitals exhibited improved outcomes, particularly regarding mortality and failure-to-rescue (FTR) rates. Similarly,

a comprehensive study analyzing 3,877 hospitals in the USA confirmed these favorable patient outcomes (38). Magnet institutions systematically enhance clinical outcomes by employing highly qualified nursing personnel, delivering patient-centered care, and fostering continuous quality improvement. Crucially, establishing a healthy work environment drives nurse job satisfaction and retention while directly ensuring patient safety and superior care delivery (4,6,8). Magnet organizations concurrently foster a supportive professional climate for staff and maximize patient care quality and safety by retaining qualified nurses, advancing evidence-based practices, and achieving superior clinical outcomes (2,4-6,39-48). However, some studies did not find a statistically significant difference in mortality rates and FTR between Magnet and non-Magnet hospitals (49), as well as studies that did observe a statistically significant difference in mortality rates between Magnet hospitals (19,50).

Subgroup analyses showed that the heterogeneity mainly stemmed from the data collection period of the studies. In other words, heterogeneity arose from the temporal differences across studies. Longer data collection periods more reliably reflect effect sizes on patient outcomes. Publication bias analyses showed that the meta-analysis results were reliable and unbiased. This indicates that current studies in the literature generally reflect the positive effects of magnet hospitals. In conclusion, the patient, nurse, and organizational outcomes of Magnet hospitals make achieving Magnet status a valuable goal for all hospitals.

This study had certain limitations. First, the research protocol was not prospectively registered in an international database such as PROSPERO. Second, the meta-analysis included a small number of studies. Third, the meta-analysis did not include patient outcomes other than mortality rate and FTR. Finally, the methodological diversity of the studies included in the meta-analysis and the use of different data collection tools may limit the generalizability of this review's results.

2. Sonuç/Conclusion

The magnet hospital model has emerged as an effective approach to increase patient safety and quality of care. This demonstrates that the magnet hospital model can serve as an important reference for improving patient safety and nursing care quality in terms of health policies and hospital administration. Applying these findings in clinical practice can improve patient outcomes and increase the effectiveness of healthcare services.

Future research should use meta-analyses to examine hospitals in the magnet process and other patient outcomes to assess the impact of the magnet model. Additionally, because no hospitals in countries such as Türkiye have magnet status, implementing this model would be an important step toward improving healthcare quality.

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