


# Analysis of the correlation between operational performance and profitability over time in public hospitals

 Syed Raziuddin Ahmad<sup>1\*</sup>,  Imran Ahmad Khan<sup>2</sup>

<sup>1</sup>Faculty of Business Studies, Arab Open University, Saudi Arabia.

<sup>2</sup>Pacelile Corporate Consulting, India.

\*Corresponding author: Syed Raziuddin Ahmad (Email: [sradiuddin@arabou.edu.sa](mailto:sradiuddin@arabou.edu.sa))

## ABSTRACT

**Purpose** The public hospitals are not-for-profit entities, and their purpose is not to generate and distribute profits as a result of business activities. Therefore, in the context of hospital management, where many hospitals are running into losses and improving profitability has become a major issue, it is necessary to study the relationship between operational performance and profitability.

**Design/Methodology/Approach:** In this study, targeting public hospitals, an empirical study was attempted on the correlation between operational performance and profitability. The 303 hospitals were analyzed for the financial years 2022 and 2023. To confirm the validity of the results for the entire group of public hospitals (population), including hospitals other than those subject to this analysis, an uncorrelated test was conducted.

**Findings:** As a result, there was a positive correlation between the volume of surgeries performed and profitability. On the other hand, the shortening of the average length of hospital stay did not lead to an improvement in profitability. Profitability improved as the number of inpatients per physician increased, but there was no correlation between the number of outpatients per physician and profitability.

**Conclusion:** The results of this study suggest the importance of index correction.

**Keywords:** Average length of hospital stay, Correlation, Frequency of surgery, Hospital management, Operational performance, Profitability.

## 1. INTRODUCTION

Patients' ratings and outcomes have received a lot of attention in recent years, but hospital financial success is also important. Financial difficulties impede an organization's efforts to adopt new technologies, recruit talented and well-trained healthcare workers, and implement the contractual and structural adjustments necessary to provide patient care in the current climate of value-based purchasing. Furthermore, inadequate financial problems have a detrimental impact on the availability and caliber of healthcare services, as they reduce access, diminish the quality of treatment, and even necessitate the closure of health care facilities. Since not-for-profit hospitals cannot sell shares to obtain equity, unlike for-profit hospitals, they must rely on retained earnings (i.e., operational surplus) as their primary source of capital. Therefore, both for-profit and non-profit hospitals must consider hospital profitability.

Research on the operational drivers of hospital profitability is inconsistent and inconclusive. Understanding how profitability has changed over time and researching the elements linked with operational effectiveness is so critical.

The financial realm of hospital performance is the focus of this study. All hospitals must operate well financially. Hospitals, regardless of ownership, must earn sufficient returns to provide community benefits, or shareholder rewards. As a result, it is critical to identify the operational variables that determine hospital profitability over time.

## 2. LITERATURE REVIEW

In the hospital industry, especially in the public hospital group, where many hospitals are loss-making, improving profitability is a major issue. However, while there have been some studies on the relationship between profitability and financial indicators such as personnel cost-to-revenue ratio (Adhikari & Sapkota, 2019; Ali et al., 2022; Anagnostopoulou & Stavropoulou, 2023; Carroll, Euhus, Beaulieu, & Chernew, 2023; Harikumar & Saleeshya, 2021; He, Jessri, & Zhang, 2022; Iqbal, Affandi, & Hermawan, 2023; Karim, Nevola, Morris, Tilford, & Chen, 2021; Langabeer, Lalani, Champagne-Langabeer, & Helton, 2018; Lee, Han, & Lee, 2023; Lee & Park, 2015; Lu, Shon, & Park, 2022; Ly & Cutler, 2018; Mahdiyan, Dehghani, Tafti, Pakdaman, & Askari, 2019; Mishra et al., 2022; Suarez, Lesneski, & Denison, 2011; Victor & Paulo, 2023), studies on the relationship between operational performance<sup>1</sup> and profitability are limited (Karim, Holmes, & Pink, 2015; McCue & Thompson, 2006; Moazzez & De Virgilio, 2016; Perry & Bold, 2021; Rosko, Al-Amin, & Tavakoli, 2020).

McCue and Thompson (2006) examined the financial and operating performance of newly established hospices relative to existing hospices. The median values of operating and financial performance metrics were compared using a nonparametric median test between newly founded hospices and existing hospices. According to the findings, longer periods of stay enabled these newer hospices to boost income and enhance overall profitability. Karim et al. (2015) found that the degree of surgery performed was not correlated with profitability, while a shorter average length of stay after adjusting for disease composition was correlated with higher profitability in a group of hospitals. Moazzez and De Virgilio (2016) also found that the degree of surgery and the average length of stay were uncorrelated with profitability in hospitals, while an improvement in bed utilization was correlated with an improvement in profitability. Rosko et al. (2020) examined the relationship between efficiency and hospital profitability. To assess hospital efficiency, they employed stochastic frontier analysis. They found that more efficient hospitals were also more profitable. Perry and Bold (2021) found that the profitability of public hospitals was uncorrelated with the number of surgeries performed and the average length of hospital stay, while there was a positive correlation between the profitability and the bed utilization rate, the ratio of beds subject to room charge difference, and the number of inpatients and outpatients per physician. Furthermore, Wu (2023) applies DEA and SFA to measure the financial efficiency of hospitals. He found that the profitability of hospitals can be improved by reducing medical costs and manpower and by enhancing human intelligence.

However, all of these studies analyzed the relationship between operational performance and profitability at a single point in time (a single fiscal year) and did not analyze the relationship between operational performance and profitability based on changes between two points in time (between two fiscal years). In other words, conventional studies have clarified what operational performance is higher in more profitable hospitals at a certain point in time, and inferred improvement in profitability through improvement in operational performance from this. However, it is more effective to infer the improvement in profitability by improving operational performance based on the relationship between the direction and amount of change in operational performance and the direction and amount of change in profitability between two points in time at each hospital.

In this paper, we analyze the correlation between business performance and profitability over time to infer an improvement in profitability due to an improvement in business performance. Please note that this is only an inference based on the correlation between business performance and profitability and does not clarify the causal relationship between the two.

## 3. RESEARCH METHODOLOGY

### 3.1. Target Hospitals

Public hospitals are included because data on operational performance, such as bed utilization and the number of patients per physician are published at the individual hospital level in the year book and are available. The publication of such data is limited to public hospitals, and even in cases where hospitals choose to disclose this information freely, the calculation of indicator data is often not standardized. The reason for including public hospitals is that individual hospital data on the frequency of surgical procedures and the average length of stay are published in the Public Enterprises Survey Reports published by the Department of Public Enterprises, Ministry of Finance.

---

<sup>1</sup> The operational performance here is the performance of indicators that are related to the operations themselves, like how many surgeries are done and how many hospital beds are used. This is different from the financial performance, which is measured by indicators like income, expenses, profits, and losses, which are not related to operations.

For public hospitals, financial data are also basically disclosed for each hospital individually through yearbooks. For private hospitals (medical corporation hospitals), although the financial statements of the corporation as a whole are available, the financial statements of the hospitals within the corporation are not disclosed, so pure financial data for the hospitals alone is not available.

Therefore, this study attempts to conduct a quantitative study of public hospitals by linking data for each hospital for FY2022 and FY2023 from the source: the Yearbook (Ministry of Health and Family Welfare). The reason why the data for FY2022 and FY2023 were selected is that there was no revision of medical service fees (medical service prices) between these two fiscal years. Since medical service fees are revised every two years, the profitability of each hospital changes between the two years, even if the business performance remains unchanged, and the relationship between business performance and profitability cannot be properly analyzed<sup>2</sup>.

### 3.2. Indicators for Analysis

The following indicators related to the degree of surgery performed, number of hospitalization days (process efficiency), utilization of hospital beds, and physician utilization status, which are obtained from the annual report are used as business results to analyze the correlation with changes over time in various profitability indicators to see the effect on profitability improvement, as in [Perry and Bold \(2021\)](#).

First, the percentage of patients who underwent surgery is used as the level of surgical procedures performed. The percentage of patients who underwent surgery is the ratio of the number of inpatients (cases) who underwent surgery to the total number of inpatients (cases), and the higher this indicator is, the higher the degree of surgery performed in that hospital. However, this indicator has a problem in that it increases if the total number of inpatients decreases, even if the number of surgical admissions remains unchanged at each hospital. In addition, even if the number of surgical admissions itself increases, the percentage of surgical admissions may be lower if the total number of admissions also increases significantly. Therefore, in this study, we also analyze the relationship between the number of surgical admissions itself as an indicator, i.e., the total number of surgical admissions, and the profitability of the hospital. However, the size of the number of surgical admissions over time is affected by the size of each hospital, while the profitability index is adjusted by the size of each hospital (revenue, number of beds, assets, and number of staff), except for the amount of medical profit. Therefore, analyzing the relationship between profitability and profitability is not problematic for the direction of change (increase or decrease), but it is problematic for the degree of change (increase or decrease in quantity). Therefore, we also analyzed the correlation between the number of surgical admissions per hospital bed and profitability, controlling for the number of beds, which is the most common measure representative of hospital size<sup>3</sup>.

As the average length of stay per patient, we first use the uncorrected usual average length of stay based on the actual disease composition of the hospital and the actual length of stay at the hospital for each disease. However, because the number of days required to provide medical care inevitably differs depending on the type of disease, the usual average length of stay is affected by the differences in the disease composition of patients admitted to each hospital, and does not fully reflect the process efficiency of each hospital. Therefore, we also use the average length of stay after adjusting for disease composition, which is calculated by changing the actual disease composition of each hospital to the national average disease composition and applying the actual length of stay for each disease to each hospital. This adjusted average length of stay is an indicator that better reflects the efficiency of the medical treatment process<sup>4</sup>.

---

<sup>2</sup> Even though the analysis targets a group of public hospitals, which are similar to some extent, the role of each hospital in the region and the number of physicians that can be secured are quite different between metropolitan and non-urban areas. Therefore, it has been pointed out that unless the relationship between operational performance and profitability is examined after further segmentation of the public hospitals, the relationship that is useful for decision-making at each hospital in each region will not become clear. This is a very important viewpoint, but further segmentation analysis is an issue for the future.

<sup>3</sup> [Perry and Bold \(2021\)](#), looked at the relationship between operational performance and profitability at a single point in time. They did not look at the correlation between the number of surgeries performed as a quantity and profitability. However, to see if the results would be the same for an analysis based on changes between two time points, which is what this section is about, we also looked at the correlation between the numbers of hospitalized patients per hospital.

<sup>4</sup> The differences in the disease composition of each hospital are the result of reflecting the disease composition of the region in which they are located and the different roles of each hospital in the region (strengths and weaknesses of each hospital's medical system, etc.). Therefore, some have pointed out that the average length of hospital stay after adjusting the disease composition to the national average may greatly distort the reality of each hospital. Although the authors also have such concerns, from the perspective of process efficiency, we believe that the corrected average length of stay is relatively more appropriate than the uncorrected average length of stay, and in fact, this corrected value is used as part of the functional evaluation coefficient as an indicator of efficiency in the reimbursement system.

Also, to show how hospital beds are being used, we will use the utilization rate of general beds (hereafter referred to as the bed utilization rate<sup>5</sup>), which shows how full acute care hospital beds are, from the Yearbook and the ratio of the total number of beds subject to room charge difference (hereafter referred to as the ratio of beds subject to room charge difference), which can show when there are more beds than rooms available. However, the ratio of beds subject to the difference in room charge only represents the percentage of beds for which the difference in room charge can be greatly improved and does not reflect the actual extent to which the high-value-added beds are used.

In the same way, the number of inpatients per physician and the number of outpatients per physician, which are obtained from the yearbook, are used as indicators of the utilization status of physicians<sup>6</sup>. However, while outpatient revenue accounts for about 30% of medical practice revenue<sup>7</sup>, medical practice profits are derived from both inpatient and outpatient services (since medical practice profit data from inpatient and outpatient services is not available), so the analysis of the relationship between the number of outpatients per physician and profitability has significant limitations and should be limited to reference purposes only.

On the other hand, as profitability indices, we use net medical profit margin, net medical profit per hospital bed, net medical profit on depreciable fixed assets, and net medical profit per staff, which can be calculated from the Annual Report, as in [Perry and Bold \(2021\)](#). In this study, net medical profit itself was also used as an indicator for analysis. However, while the change in net medical profit over time is affected by the size of the hospital, the performance indicators except for the number of surgical admissions are controlled by the size of the hospital. Therefore, when analyzing the relationship between the two, it should be noted that, except for the relationship with the number of surgical admissions, the direction of change (increase or decrease) is acceptable, but the degree of change (increase or decrease in quantity) is problematic.

In calculating the profitability index, pure medical revenue is calculated by deducting contributions from other accounts from medical revenue in the income statement of individual hospitals in the Annual Report, and net medical profit is calculated by deducting medical expenses from the net medical revenue (so-called net medical profit). Therefore, the net medical profit in the profitability index excludes the effects of offsetting deficits due to various subsidies, contributions, and transfers from other accounts. In addition, the profit is calculated from the revenues and expenses of the medical practice and does not include the revenues and expenses of the nursing school and others. Therefore, the profitability indices used in this study reflect pure profitability from medical practice operations.

Although income statement data is known and published for each hospital when a city has multiple hospitals, balance sheet data is published for all hospitals, and the total amount of assets for each hospital is not available. However, for depreciable fixed assets, which account for 60.5 percent<sup>8</sup> of total assets, the depreciable fixed assets per bed (based on the total number of beds) are published for each hospital. In this study, the amount of depreciable fixed assets was calculated by multiplying this published data by the total number of beds, and the net medical profit margin on depreciable fixed assets was calculated instead of the medical profit margin on total assets, which was used as an indicator of profitability relative to asset value. However, since the published amount of depreciable fixed assets per bed is the amount of assets after depreciation, the amount of depreciable fixed assets per bed is almost fully depreciated in the case of hospitals built a long time ago, while the amount of depreciated fixed assets per bed is not yet fully depreciated in the case of hospitals built in recent years. Therefore, even among hospitals that were built with almost the same amount of investment and operate with the same level of profit and loss in terms of bed utilization, there is a problem that the net medical profit margin on depreciated

---

<sup>5</sup> The bed utilization rate in the "Annual Report" is calculated by dividing the annual total number of inpatients by the annual total number of licensed beds (= 365 days x number of licensed beds). The annual total number of inpatients and outpatients refers to the annual total number of inpatient days (an index based on one inpatient day per unit) and the total number of outpatient days (an index based on one outpatient visit per unit), which are different from the actual number of patients and cases. Incidentally, the ratio of outpatients to inpatients is also presented as the ratio of the total number of inpatients to outpatients on an annual basis.

<sup>6</sup> The number of inpatients and outpatients per physician in the yearbook is calculated by the number of inpatients and outpatients divided by the number of doctors.

<sup>7</sup> Based on the total data in the summary table (income statement) of the Yearbook (Hospital Business) for FY2022, the ratio of outpatient revenue to net medical revenue was 29.2%.

<sup>8</sup> Based on the total data of the summary table (balance sheet) in the Yearbook (Hospital Business) for FY2022, the amount of depreciable fixed assets accounted for 65.0% of total assets on a book value basis after depreciation.

fixed assets differs greatly because the amount of depreciated fixed assets differs significantly depending on the construction period<sup>9</sup>.

In addition, while return on investment is one of the most important indicators in general industry, hospitals, as non-profit organizations, that are prohibited from sharing profits with their investors, do not have the concept of making profits commensurate with the amount of capital (assets) invested in the first place. Therefore, neither return on assets nor return on depreciable fixed assets is an indicator that hospital management or investors in hospitals pay attention to and try to improve. Therefore, they were included in the analysis only as informative indicators.

Net medical profit per staff member was also included in the analysis as a reference indicator because the total number of staff members in the yearbook may not have been compiled according to the common definition among all public hospitals. In other words, there is no distinction between regular staff and temporary staff, and the data on the number of staff may not be consistent among hospitals. In this study, we use the total number of staff data from the Survey of Facilities and Business Conditions in the annual report, but the total number of staff data from the Survey of Salaries by Job Category in the same annual report is a little low in some hospitals, and the total number of staff data used in this study seems to include non-regular staff, but this is not clear. In addition, when temporary staff are included, some hospitals calculate the total number of staff by converting them to full-time equivalents, while others simply calculate the total number of staff without converting them to full-time equivalents, and this may not be consistent among hospitals.

In addition, there are hospitals where the total number of staff is announced as one to several, which indicates that the total number of staff is not the total number of staff of the hospital, but the total number of staff of the hospital division of the city hall or the headquarters of the hospital business agency that has been externalized. The staffing data<sup>10</sup> for such hospitals with single-digit staffing totals was treated as unavailable data in advance.

### *3.3. Basic Statistics for the Indicator under Analysis*

From the yearbook data for two consecutive fiscal years containing data for FY2022 and FY2023, which were the latest data available at the time of the study without the latest revision of medical fees, 333 hospitals were able to link to individual hospital data. As used in [Perry and Bold \(2021\)](#), data for 337 hospitals were available in FY2022, but in FY2023, there were five hospitals for which financial data were not published. In addition, there were two hospitals whose medical revenue was derived only from the revenue from contributions to other accounts, leaving a total of 330 hospitals for which profitability indices, which are indispensable for this analysis, could be appropriately obtained.

However, although the business performance indicators are indicators related to inpatient services, profitability indicators are affected by both inpatient and outpatient services, so in the case of hospitals where the impact on profitability from outpatient services was significantly different in FY2022 and FY2023<sup>11</sup>, it is not possible to properly analyze the correlation between changes in inpatient operational performance and changes in profitability. In other words, it becomes difficult to distinguish whether the change in profitability is due to a change in the performance of inpatient services or a change in the financial impact of outpatient services due to a change in the level of dependence on outpatient services. Therefore, we used the outpatient hospital ratio index in the yearbook to see if any hospitals experienced a significant change in their dependence on outpatient services. Specifically, we analyzed whether there were any hospitals whose outpatient hospitalization ratios changed significantly enough over time from FY 2022 to FY 2023 to make them outliers, and found that 6 hospitals fell into this category. As a result, the ratio of change over time in the ratio of outpatients to inpatients in the remaining 324 hospitals was approximately 20%, even in the largest hospital, and only 10 hospitals (3.1%)<sup>12</sup> exceeded 10%.

---

<sup>9</sup> Similarly, in the case of return on total assets, there is a problem of the difference in the degree of depreciation due to differences in the construction period, but the problem is relatively small because land and current asset amounts are included.

<sup>10</sup> Among the public hospitals covered in this study, the same 14 hospitals had a single-digit total number of staff in both 2022 and 2023.

<sup>11</sup> Although it is not possible to properly analyze the correlation between inpatient operational performance and profitability in hospitals where the financial impact of outpatient operations is extremely high even on a single-year basis, no hospital was found to have an outpatient dependency ratio high enough to be considered an outlier as far as the outpatient inpatient ratio is concerned ([Perry & Bold, 2021](#)).

<sup>12</sup> Whether a 20% change in outpatient dependency is problematic, or whether even 10% is considered problematic, and to what degree of change in outpatient dependency in the first place should be considered as not allowing appropriate analysis is a subjective judgment. Therefore, to reduce the discretion (subjectivity) of the analyst, this time we conducted an outlier test (Smirnov-Grubbs test, at 0.1% level of significance), which has been consistently used for various profitability and operational performance indicators in previous related studies ([S. Karim et al., 2015](#); [Moazzez & De Virgilio, 2016](#); [Perry & Bold, 2021](#)), to determine whether the level of external dependence is a problem or not. Hospitals with large changes in the level of external dependence at the outlier level were excluded from the analysis.

In addition, public hospitals are classified into three types in terms of legal application classification: full application of ordinances, financial application only, and local independent administrative corporations. Therefore, if each hospital changes its application of the law or its legal form in FY2023, the profitability may have changed due to the change, and the impact of the change in the legal application category on profitability and the impact of the change in operational performance on profitability may be mixed, and the correlation between operational performance and profitability may not be properly analyzed. Therefore, we investigated whether any hospitals changed the application of the law or the type of law from FY2023, and found that 11 hospitals changed from financial-only application to full application, 6 hospitals changed from financial-only application to sole application, and 4 hospitals changed from full application to sole application. Therefore, these 21 hospitals were excluded from the analysis.

The 303 hospitals were selected for the analysis, excluding the 21 hospitals that changed their legal applications in FY2023. We then calculated the changes (differences) between FY2022 and FY2023 in each profitability indicator and business performance indicator for these 303 hospitals and created a data set of changes in each indicator for the 303 hospitals. The Smirnov-Graves test was conducted on this data set of indicators to check for extreme outliers (changes) for each indicator, and data that were determined to be outliers at the 0.1% level of significance were eliminated. Considering the various indicators used in this study, it is not appropriate to consider a 1% level to be an outlier, and only data with a significance level of 0.1%, which is considered to be an extreme outlier, were subject to removal. Since outliers were removed for each indicator, we decided not to remove any outliers from the bivariate scatter plots to eliminate arbitrariness. As a result, the amount of data (n) for each indicator subjected to correlation analysis among changes is shown in [Table 1](#). [Table 1](#) also shows the basic statistics for the changes in each indicator.

To confirm the validity of the results for the entire group of public hospitals (population), including hospitals other than those subject to this analysis, an uncorrelated test was conducted. In principle, a correlation coefficient of  $\pm 0.2$  or more to less than  $\pm 0.3$  is considered very weakly correlated, a correlation coefficient of  $\pm 0.3$  or more to less than  $\pm 0.4$  is considered weakly correlated, and a correlation coefficient of  $\pm 0.4$  or more is considered moderately correlated. However, since the present study has a sufficient sample size, even very weak correlations are statistically significant. Correlations that are significant at the 1% level are discussed as having very weak correlations even if they are less than  $\pm 0.2$ . In addition, though significant correlations were found at the 5% level even with correlation coefficients of  $\pm 0.15$  or less, it would be difficult to say that there is a substantial correlation, although the correlation does not seem to be uncorrelated in the population.

**Table 1.** Basic statistics for each indicator change.

Basic statistics	Profitability indicators				
	Net medical profit (Thousand rupees)	Net medical profit margin	Net medical profit per bed (Thousand rupees)	Net medical profit margin on depreciated fixed assets	Net medical profit per staff (Thousand rupees)
n	301	297	303	273	288
Average	-7.810	0.15%	-35	-0.27%	3
Median	2.379	0.16%	2	-0.09%	9
S.D.	242.101	3.48%	648	3.68%	476

**Table 1.** Continue....

Basic statistics	Degree of operation			Average days in hospital		Utilization of beds		Physician availability	
	Percentage of inpatients undergoing surgery	Number of inpatients undergoing surgery	Number of surgical admissions per hospital bed	Actual value without correction	Disease composition correction value	Bed utilization rate	Percentage of beds subject to room charge difference	Number of inpatients per physician	Number of outpatients per physician
n	302	301	302	301	302	302	238	266	267
Average	-0.13%	20	0.10	-0.13	0.06	-0.10%	0.01%	-0.15	-0.21
Median	-0.11%	15	0.07	-0.15	0.10	-0.20%	0.00%	-0.10	-0.20
S.D.	1.88%	89	0.29	0.77	0.86	3.65%	0.19%	0.35	0.62



**Table 2.** Results of correlation analysis between business performance and profitability<sup>13</sup>.

Correlation between business performance and profitability	Degree of operation			Average days in hospital		Utilization of beds		Physician availability	
	Percentage of inpatients undergoing surgery	Number of inpatients undergoing surgery	Number of surgical admissions per hospital bed	Actual value without correction	Disease composition correction value	Bed utilization rate	Percentage of beds subject to room charge difference	Number of inpatients per physician	Number of outpatients per physician
Net medical profit	(0.0891)	0.2072*	(0.1967*)	(0.0191)	(-0.0343)	(0.2633*)	(-0.0968)	(0.1150)	(0.0760)
Net medical profit margin	0.0927	(0.3451*)	0.2241*	0.0012	-0.0454	0.3353*	-0.0821	0.1494***	0.0825
Net medical profit per bed	0.0602	(0.3083*)	0.1149***	0.0341	-0.0077	0.3013*	-0.0370	0.1612**	0.0892
Net medical profit margin on depreciated fixed assets	0.0654	(0.2435*)	0.1934**	0.0012	-0.0560	0.2860*	-0.0519	0.1854**	0.0211
Net medical profit per staff	0.0955	(0.3361*)	0.2160*	0.0524	-0.0325	0.3167*	-0.0653	0.1656**	0.0621

**Note:** \* is significant at 0.1%, \*\* is significant at 1%, and \*\*\* is significant at 5%.

**Table 3.** Correlations between the degree of surgery performed as a volume and profitability (Based on a single point in time).

Basic statistics	Number of surgical admissions per hospital bed		Correlation between surgical procedures (Volume) and profitability	Number of surgical admissions per hospital bed	
	337 hospitals	265 hospitals		337 hospitals	265 hospitals
N	337	265	Net medical profit margin	0.0106	0.0972
Average	3.67	3.77	Net medical profit per bed	0.0557	0.0653
Median	3.73	3.81	Net medical profit margin on depreciated fixed assets	0.0093	0.0647
S.D.	1.15	1.07	Net medical profit per staff	0.0205	0.0868

<sup>13</sup> The correlation coefficients in parentheses in Table 2 are for reference only.



#### 4. ANALYSIS RESULTS

As for the relationship between the degree of surgical procedures and profitability, as shown in [Table 2](#), the changes over time in the degree of surgical procedures as a percentage of the total number of inpatients (cases) who underwent surgery and the changes over time in various profitability indicators are the same as the results of the correlation analysis between operational performance and profitability at the same hospital group ([Perry & Bold, 2021](#)) at one point in time (single year). There is no correlation in either case. On the other hand, there were significant and extremely weak positive correlations between changes over time in the number of surgical admissions and the number of surgical admissions per hospital bed and changes over time in various profitability indices<sup>14</sup>. In other words, it can be inferred that an increase in the volume of surgeries performed improves profitability.

Regarding the link between the average length of stay and profitability, [Perry and Bold \(2021\)](#) looked at the relationship between operational performance and profitability at a single time in point for the same group of hospitals. They found that there was no link between the change over time in the average length of stay without correction and the change over time in the average length of stay for disease composition, which is better reflection of how well the process worked. The change over time in both profitability indices was uncorrelated. In the group of public hospitals, based on the correlation analysis of the change over time between two time points, it appears that the shortening of an average length of stay did not lead to an improvement in profitability. However, profitability did not deteriorate even when the average length of stay was shortened, and profitability was maintained.

Furthermore, when we look at the relationship between bed utilization and profitability, we find a weak positive correlation that is highly significant, similar to [Perry and Bold \(2021\)](#). In the group of public hospitals, the improvement in bed utilization rate seems to be associated with the improvement in profitability. On the other hand, when we look at the relationship between the ratio of beds subject to room charge differential and profitability, unlike [Perry and Bold \(2021\)](#), who found a significant, albeit very weak, positive correlation, no correlation was found for any profitability index in the correlation analysis of changes over time between two-time points. Unlike measures to improve the utilization rate of hospital beds, measures to add value to hospital beds do not seem to be necessarily related to profitability<sup>15</sup>.

Next, the relationship between the number of inpatients per physician and profitability is significantly positively correlated with all profitability indicators except net medical profit, although the correlation is very weak. It can be inferred that profitability improves as the number of inpatients per physician increases and the utilization ratio of physicians' increases. The relationship between higher physician utilization rate and higher profitability is clearer than in the analysis of the correlation between business performance and profitability at a single point in time for the same group of hospitals ([Perry & Bold, 2021](#)). On the other hand, when looking at the relationship between the number of outpatients per physician and profitability, there is no correlation between any of the profitability indices, and it appears that even if a physician treats more outpatients per physician, it does not lead to improved profitability.

#### 5. DISCUSSION

The degree of surgery performed as a percentage of procedures performed did not correlate with profitability, similar to the results of the correlation analysis of the correlation between the performance of operations and profitability at a single point in time for the same hospital group ([Perry & Bold, 2021](#))<sup>16</sup>. On the other hand, when we look at the degree of surgery performed as the amount of surgery performed, the result differs from the result when looking at the degree of surgery performed as the percentage of surgery performed, and it appears that this is linked to an improvement in profitability. However, it should be noted that the relationship appears to differ

---

<sup>14</sup> Incidentally, an analysis of the correlation between the number of surgeries performed (number of inpatients admitted for surgery per bed) as a quantity at a point in time and profitability in the same hospital group showed no significant correlation, unlike the correlation for changes over time [Table 3](#).

<sup>15</sup> It has been pointed out that even if there is a correlation between the percentage of beds subject to a room charge difference and profitability, the interpretation of the causal relationship is difficult. In other words, there are hospitals that set up and increase the number of beds for differential charges by reducing the number of beds that cannot be filled and using the space to create private rooms to improve profitability, while there are hospitals that invest in expansion and renovation because they are profitable, resulting in an increase in the ratio of beds for differential charges.

<sup>16</sup> The reason for this is that some hospitals simply accept the decrease in the number of surgeries, while others intentionally reduce the number of surgeries because they cannot secure surgical facilities or anesthesiologists and try to secure profitability by shifting cancer treatment to outpatient chemotherapy instead. Therefore, some hospitals have commented that the decrease in the percentage of inpatients undergoing surgery may not simply lead to a worsening of profitability.

depending on the choice of the index to be analyzed. In this study, we additionally analyzed the correlation between the degree of surgery performed and the volume of surgery performed at a single point in time (single year) and profitability and found no correlation at all [Table 3](#).

As for the relationship between the average length of stay and profitability, the shortening of the average length of stay does not seem to lead to an improvement in profitability, while it does not seem to lead to a deterioration in profitability, both in the average length of stay after correction for disease composition and in the average length of stay under normal conditions. However, the weak positive correlation (correlation coefficient of 0.3182) between the uncorrected average length of stay and bed utilization suggests that shortening the average length of stay leads to a slight decrease in bed utilization. Therefore, it is considered that profitability is maintained not because new patients are secured enough to maintain the bed utilization rate but because high-density medical treatment is provided to each patient in the process of shortening the length of hospital stay<sup>17</sup>. In contrast to the results of the correlation analysis ([Perry & Bold, 2021](#)), which showed that the reduction in the average length of stay did not result in a decrease in bed utilization, the hospitals were able to attract enough patients to maintain bed utilization, which was thought to have helped them maintain profitability. It is important to note that even when the same group of hospitals is analyzed at the same time, the background (reasons for maintaining profitability under shortened lengths of stay) may appear different depending on the analysis method, even if the relationship between average length of stay and profitability is the same.

Next, when the utilization of hospital beds is examined in terms of the bed utilization ratio, the improvement in the utilization ratio appears to have improved profitability<sup>18</sup>. On the other hand, when the utilization of hospital beds is examined not in terms of utilization but in terms of the ratio of beds subject to the room charge differential, which is a status of high value-added, there is no relationship with profitability. However, it should be noted that the indicator ratio of beds subject to room charge difference is a rather limited analysis result because, as already pointed out, it is only a set ratio of the number of high-value-added beds to the total number of beds and does not reflect the actual utilization of the beds at all. [Perry and Bold \(2021\)](#) found a positive, albeit very weak, correlation, and although this is an indicator that is only a set ratio, the analysis also confirmed that hospitals with a higher ratio of high-value-added beds tend to be more profitable, suggesting that a positive correlation with profitability can probably be observed if the high-value-added beds are utilized.

Furthermore, regarding the relationship between the utilization status of physicians and profitability, it appears that an improvement in the utilization status leads to an improvement in profitability, although the relationship is extremely weak when looking at the number of inpatients per physician. In contrast, a lack of correlation is observed when examining the ratio of outpatients to physicians. One reason for this may be that the ratio of outpatient revenue to total hospital medical revenue is low, at less than 30%, which has a small impact on the profitability of outpatient operations. Regardless of the reason, it should be noted that this result is somewhat different from the result of the correlation analysis between the two ([Perry & Bold, 2021](#)), in which the improvement in the number of outpatients per physician also seems to have some relationship to the improvement in profitability.

## 6. CONCLUSION

Although the results of this study were limited to a group of public hospitals, the relationship between various operational performances and profitability in the hospital community was evident.

Even in studies of the same group of hospitals at the same period, it was found that the results of the analysis based on the business performance and profitability at a single point in time (a single year) and the analysis based on the changes in business performance and profitability over time between two points in time are often similar, but some of the results are different. The reality that a hospital with better performance is more profitable in

---

<sup>17</sup> However, the implementation of high-density medical treatment for each patient (increase in the unit price per patient per day) does not lead to an improvement in profitability. To improve profitability while shortening the average length of stay, it is necessary to increase the ability to attract patients by strengthening regional cooperation.

<sup>18</sup> For the business performance indicators that showed significant correlations with profitability, we analyzed the correlations between the indicators and other business performance indicators to see if there was any relationship between them. The only indicator that showed some degree of correlation of  $\pm 0.3$  or more was between bed utilization and the uncorrected average length of stay (correlation coefficient of 0.3182). Since an increase or decrease in the bed utilization rate due to an increase or decrease in the adjusted average length of stay can be assumed in practice, the correlation between the bed utilization rate and the number of beds available after controlling for the effect of the average length of stay was almost the same as the simple correlation coefficient. The single correlation coefficient was 0.2633 with net medical profit, 0.3353 with medical profit margin, and 0.3013 with net medical profit per hospital bed, while the partial correlation coefficient was 0.2714 with net medical profit, 0.3533 with medical profit margin, and 0.3065 with net medical profit per hospital bed.

terms of certain operational performance and the reality that a hospital that has improved its operational performance over time is more profitable over time are not necessarily the same, although they agree in many cases.

Furthermore, it is also clear that the relationship with profitability appears to be different between the performance of operations as a volume of operations and the performance of operations as a percentage of operations, even when similar indicators are used to measure the same operational performance (degree of operations performed). It is important to note that the inferences based on the results may differ depending on how the indicator of operational performance is set.

Overall, our findings have two managerial implications. They first show managers where they can improve. It is one of the few studies that examines the relationship between operational performance and profitability in the hospital industry experimentally. Second, they outline how to quantify the benefits of those enhancements, allowing managers to do a cost-benefit analysis of various operational performance indicators.

Although there are several views on the relationship between operational performance and profitability in hospitals, the relationship has not always been quantitatively clarified. In this study, we were able to clarify part of this relationship for a group of public hospitals, but this is still insufficient. Although there is a limitation on data availability, further research in this area is expected to be conducted, including studies on groups of hospitals affiliated with medical corporations.

#### **FUNDING**

This research is supported by Arab Open University, Saudi Arabia (Grant number: AOURG-2023-018).

#### **INSTITUTIONAL REVIEW BOARD STATEMENT**

The Ethical Committee of the Arab Open University, Saudi Arabia has granted approval for this study (Ref. No. 524008).

#### **TRANSPARENCY**

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

#### **COMPETING INTERESTS**

The authors declare that they have no competing interests.

#### **AUTHORS' CONTRIBUTIONS**

Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

#### **ARTICLE HISTORY**

Received: 27 July 2023/ Revised: 13 October 2023/ Accepted: 7 November 2023/ Published: 20 December 2023

**Copyright:** © 2024 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

#### **REFERENCES**

- Adhikari, S. R., & Sapkota, V. P. (2019). Measuring hospitals performance: Applying the management approach in Nepal. *International Journal of Healthcare Management*, 12(4), 292-301. <https://doi.org/10.1080/20479700.2018.1500770>
- Ali, I., Uddin, M., Senan, N. A. M., Sami, S., Baig, A., Garg, R., . . . Khan, I. A. (2022). A study on management discretion of municipal hospital managers and its hindering factors. *International Journal of Innovative Research and Scientific Studies*, 5(2), 67-82. <https://doi.org/10.53894/ijirss.v5i2.390>
- Anagnostopoulou, S. C., & Stavropoulou, C. (2023). Earnings management in public healthcare organizations: The case of the English NHS hospitals. *Public Money & Management*, 43(2), 95-104. <https://doi.org/10.1080/09540962.2020.1866854>
- Carroll, C., Euhus, R., Beaulieu, N., & Chernew, M. E. (2023). Hospital survival in rural markets: Closures, mergers, and profitability: Study examines rural market hospital closures, mergers, and profitability. *Health Affairs*, 42(4), 498-507. <https://doi.org/10.1377/hlthaff.2022.01191>
- Harikumar, P., & Saleeshya, P. (2021). A systems approach to mapping performance in Indian healthcare organizations. *International Journal of Healthcare Management*, 14(4), 1134-1147. <https://doi.org/10.1080/20479700.2020.1752990>
- He, M., Jessri, M., & Zhang, H. (2022). The impact of COVID-19 on hospitals' financial performance: Evidence from California hospitals. *International Journal of Healthcare Management*, 1 1-8.

- Iqbal, M., Affandi, A., & Hermawan, A. (2023). Analysis of differences in financial performance before and after the implementation of the national health guarantee: Case study at Al Islam hospital Bandung. *Transforma Jurnal Manajemen*, 1(1), 29-45. <https://doi.org/10.56457/tjm.v1i1.36>
- Karim, S., Holmes, G., & Pink, G. (2015). The effect of surgery on the profitability of rural hospitals. *Journal of Health Care Finance*, 41(4), 11-21
- Karim, S. A., Nevola, A., Morris, M. E., Tilford, J. M., & Chen, H. F. (2021). Financial performance of hospitals in the appalachian region under the hospital readmissions reduction program and hospital value-based purchasing program. *The Journal of Rural Health*, 37(2), 296-307. <https://doi.org/10.1111/jrh.12475>
- Langabeer, J. R., Lalani, K. H., Champagne-Langabeer, T., & Helton, J. R. (2018). Predicting financial distress in acute care hospitals. *Hospital Topics*, 96(3), 75-79. <https://doi.org/10.1080/00185868.2018.1451262>
- Lee, H., Han, A., & Lee, K.-H. (2023). Financial sustainability of hospitals and equity in healthcare access: Using the social resource-based view. *Public Performance & Management Review*, 1-27. <https://doi.org/10.1080/15309576.2023.2227160>
- Lee, J.-W., & Park, C.-H. (2015). Factors affecting the hospital profitability focusing on the convergence of differences in financial performance of the surplus and deficit hospital. *Journal of Digital Convergence*, 13(11), 267-276. <https://doi.org/10.14400/jdc.2015.13.11.267>
- Lu, J., Shon, J., & Park, Y. J. (2022). Beyond revenue diversification: Service diversification and service costs in nonprofit acute care hospitals. *Nonprofit Management and Leadership*, 33(2), 427-440. <https://doi.org/10.1002/nml.21530>
- Ly, D. P., & Cutler, D. M. (2018). Factors of US hospitals associated with improved profit margins: An observational study. *Journal of General Internal Medicine*, 33(7), 1020-1027. <https://doi.org/10.1007/s11606-018-4347-4>
- Mahdiyani, S., Dehghani, A., Tafti, A. D., Pakdaman, M., & Askari, R. (2019). Hospitals' efficiency in Iran: A systematic review and meta-analysis. *Journal of Education and Health Promotion*, 8, 126. [https://doi.org/10.4103/jehp.jehp\\_393\\_18](https://doi.org/10.4103/jehp.jehp_393_18)
- McCue, M. J., & Thompson, J. M. (2006). Operational and financial performance of newly established hospices. *American Journal of Hospice and Palliative Medicine*, 23(4), 259-266. <https://doi.org/10.1177/1049909106290245>
- Mishra, N. K., Ali, I., Senan, N. A. M., Uddin, M., Baig, A., Khatoon, A., . . . Khan, I. A. (2022). The effect of departmental accounting practices on organizational performance: Empirical evidence from the hospital sector in India. *The Journal of Asian Finance, Economics and Business*, 9(4), 273-285.
- Moazzez, A., & De Virgilio, C. (2016). Role of surgical services in profitability of hospitals in California: An analysis of office of statewide health planning and development annual financial data. *The American Surgeon*, 82(10), 894-897. <https://doi.org/10.1177/000313481608201007>
- Perry, L. M., & Bold, R. J. (2021). Analysis of revenue, expense, and profitability in surgical procedures. *Journal of the American College of Surgeons*, 233(6), 813-814. <https://doi.org/10.1016/j.jamcollsurg.2021.08.681>
- Rosko, M., Al-Amin, M., & Tavakoli, M. (2020). Efficiency and profitability in US not-for-profit hospitals. *International Journal of Health Economics and Management*, 20(4), 359-379. <https://doi.org/10.1007/s10754-020-09284-0>
- Suarez, V., Lesneski, C., & Denison, D. (2011). Making the case for using financial indicators in local public health agencies. *American Journal of Public Health*, 101(3), 419-425. <https://doi.org/10.2105/ajph.2010.194555>
- Victor, J., & Paulo, A. (2023). Transaction costs in healthcare: Empirical evidence from Portuguese hospitals. *Cogent Business & Management*, 10(2), 2220479. <https://doi.org/10.1080/23311975.2023.2220479>
- Wu, J.-S. (2023). Applying frontier approach to measure the financial efficiency of hospitals. *Digital Health*, 9, 1-13. <https://doi.org/10.1177/20552076231162987>