International J. Soc. Sci. & Education
2026 Vol.16, ISSN: 2223-4934 E and 2227-393X Print.

Impact of Biometric Attendance System on Staff Performance on Healthcare Employees in Kauh in Jeddah City

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Abstract

Background: Healthcare institutions increasingly adopt biometric attendance systems (BAS) to improve attendance accuracy, administrative efficiency, and workforce management. However, empirical evidence regarding healthcare employees' perceptions of such systems remains limited.

Objective: This study aimed to examine healthcare employees' perceptions of the adoption, effectiveness, and efficiency of a biometric attendance system and its association with self-reported performance at King Abdulaziz University Hospital (KAUH), Jeddah, Saudi Arabia.

Methods: A quantitative, cross-sectional study was conducted among healthcare employees at KAUH. The target population comprised approximately 4,200 employees. Using Slovin's formula, a minimum required sample size of 374 participants was calculated and achieved. Data was collected using a validated, self-administered questionnaire distributed electronically through verified institutional WhatsApp groups. Descriptive statistics summarized participant characteristics and BAS perceptions. Inferential analyses, including chi-square tests, t-tests, correlation analysis, and multiple regression, were performed to examine associations between BAS dimensions and employee performance. Reliability was assessed using Cronbach's alpha.

Results: A total of 374 valid responses were analyzed. Participants reported a high level of BAS adoption (overall mean > 4.0 on a 5-point Likert scale). Perceived effectiveness and efficiency of the system were also rated highly, particularly regarding attendance accuracy and time savings. Regression analysis demonstrated statistically significant associations between BAS adoption, perceived effectiveness and efficiency, and self-reported employee performance ($p < 0.05$). Gender and education level were significantly associated with BAS adoption. All scales demonstrated acceptable reliability (Cronbach's alpha ≥ 0.70).

Conclusion: The biometric attendance system was positively perceived by healthcare employees and showed significant associations with self-reported performance indicators. While findings suggest perceived improvements in efficiency and attendance management, conclusions are limited to associations due to the cross-sectional design. Future research using longitudinal or objective performance indicators is recommended.

Keywords*: Biometric attendance system; Healthcare employees; Employee performance; Efficiency; Effectiveness; Cross-sectional study*

Introduction

Technological advancements have become integral to modern organizational operations, particularly within the healthcare sector. Health information technologies are widely used to support patient care, administrative processes, and workforce management. Among these technologies, biometric attendance systems (BAS) have gained attention as tools for improving attendance accuracy, reducing time fraud, and enhancing administrative efficiency. (Ali et al, 2018& Rivera, 2021).

Do et al, (2020) stated that Biometric attendance systems rely on unique physiological or behavioral characteristics, such as fingerprints, facial recognition, or iris scans, to authenticate employee identity and record attendance. Joshi et al. (2018) Compared with traditional manual or card-based systems, biometric systems are considered more secure and less susceptible to manipulation. Previous studies suggest that BAS may reduce absenteeism, improve punctuality, and streamline payroll processing by providing accurate, real-time attendance data.

Despite the growing adoption of biometric technologies in healthcare institutions, empirical research examining employees' perceptions of these systems and their association with job performance remains limited, particularly in the Middle East. Understanding healthcare workers' perceptions is critical, as acceptance and perceived usefulness influences successful implementation and sustained use of technological systems. (Tyagi, et al. 2020).

Therefore, this study aimed to examine the perceived adoption, effectiveness, and efficiency of a biometric attendance system and its association with self-reported performance among healthcare employees at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia.

Aims and Objectives

To examine healthcare employees' perceptions of the biometric attendance system and its association with self-reported performance at King Abdulaziz University Hospital.

Objectives

1. To assess the level of adoption of the biometric attendance system among healthcare employees at KAUH.
2. To examine employees' perceptions of the effectiveness and efficiency of the biometric attendance system.
3. To explore associations between biometric attendance system dimensions and self-reported employee performance.
4. To examine the relationship between selected demographic variables and BAS adoption.

Methodology

Study Design

A quantitative, cross-sectional research design was employed to examine biometric attendance systems in healthcare settings.

Study Setting

The study was conducted at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia. KAUH is a tertiary care teaching hospital affiliated with King Abdulaziz University and employs a large multidisciplinary healthcare workforce.

Population and Sample Size

The target population consisted of approximately 4,200 healthcare employees working at KAUH, including clinical and administrative staff. Using Slovin's formula with a 95% confidence level, the minimum required sample size was calculated as 374 participants. A total of 374 complete questionnaires were received and included in the final analysis, yielding a complete and valid sample.

Inclusion and Exclusion Criteria

Inclusion criteria:

- Healthcare employees (clinical or administrative) currently employed at KAUH
- Willingness to participate voluntarily

Exclusion criteria:

- Non-KAUH employees
- Incomplete questionnaire responses
- Participants involved in the pilot study

Data Collection Tool

Data were collected using a structured questionnaire adapted from validated instruments developed by Williams et al. (2020) and Koopmans et al. (2013). The questionnaire consisted of five sections:

1. Demographic characteristics
2. Adoption level of the biometric attendance system
3. Perceived effectiveness and efficiency of the system
4. Employee performance
5. Challenges related to BAS use

Responses were measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Collection Procedure

Participants were recruited using verified, closed WhatsApp groups restricted to KAUH employees. Group administrators confirmed participants' institutional affiliation before granting access. The survey link allowed only one response per participant to prevent duplication. Participation was voluntary, and informed consent was obtained electronically prior to data collection.

Validity and Reliability

Content validity was ensured through adaptation from previously validated instruments. Reliability was assessed using Cronbach's alpha. All scales demonstrated acceptable internal consistency ($\alpha \geq 0.70$).

Ethical Considerations

Ethical approval was obtained from the Unit of Biomedical Ethics at KAUH (Exemption Reference No. 38-23, dated 24 July 2023). Participants' anonymity, confidentiality, and right to withdraw were ensured throughout the study.

Statistical Analysis

Data was analyzed using SPSS software. Descriptive statistics (frequency, percentage, mean, and standard

deviation) summarize participant characteristics and questionnaire responses. Inferential analyses included chi-square tests, independent t-tests, correlation analysis, and multiple regression to examine associations between BAS dimensions and employee performance. Statistical significance was set at $p < 0.05$.

Results

Participant Characteristics

A total of 374 healthcare employees participated in the study. Slightly more than half were male (53.2%). The majority were aged 31–40 years (37.7%) and held a bachelor's degree (42%). Nurses constituted the largest professional group (53.7%), followed by physicians (19.5%). Most participants had between 5 and 10 years of work experience (44.4%).

Table 1: Demographic characteristics of the participants

n=374	**Frequency**	**Percent**
Gender		
Female	175	46.8
Male	199	53.2
Age		
Less than 20 years old	25	6.7
21- 30	78	20.9
31- 40	141	37.7
41- 50	86	23
Over 50 years	44	11.8
Level of education		
High school	29	7.8
Diploma	58	15.5
Bachelors	157	42
Masters	85	22.7
PhD	45	12
Job Category		
Administrator	32	8.6

Dietician	21	5.6
Laboratory personnel	27	7.2
Nursing	201	53.7
Pharmacist	20	5.3
Physician	73	19.5
Years of Experience		
Less than 5 years	92	24.6
5 to 10 years	166	44.4
More than 10 Years	116	31
Monthly income		
Less than 5000	72	19.6
5000-10000	196	52.4
More than 10000	106	28.3
Nationality		
Non-Saudi	110	29.4
Saudi	264	70.6
Residency		
Outside the hospital	165	44.2
In hospital accommodation	209	55.8

Table 2: Adoption level of BAS) Participants reported a high level of BAS adoption. Mean scores exceeded 4.0 for most items, indicating agreement that the system was efficient, secure, and effective in recording attendance, verifying identity, and supporting.

Statistics					**n=374**
	Mean	Median	Mode	SD	Sum
Adoption level of BAS					
Fingerprints input takes lesser time for recording employee attendance	4.01	4	5	1.15	1501
Fingerprints time clocking is better than manual system	4.07	4	4	0.98	1524
Attendance data can easily be captured through computerized biometric employee clocking system	4.09	4	5	1.07	1528
Computerized biometric employee clocking system is effective in capturing employee working hours	4.08	4	4	1.02	1527
Biometrics provide a detailed audit trail of employee attendance.	4	4	4	1.06	1496
Computerized biometric clocking system ensures data integrity	4	4	4	1.1	1495
Biometrics-based authentication use individual physical traits	4.17	4	5	1.11	1560
All employee identification aspects of the system are fully secure	3.91	4	4	1.08	1462
Biometrics data is intrinsically connected to an individual employee	3.94	4	4	1.12	1472
Computerized biometric system authenticates employee identity in real-time	4.1	4	5	1.08	1533
Biometric system is a reliable way to determine employee pay.	3.99	4	4	1.1	1492
Computerized biometric employee clocking system provides accurate data for payroll computation	3.96	4	4	1.13	1481
Computerized biometric employee clocking system stores payroll accurate data	4.01	4	5	1.12	1499
Computerized biometric employee clocking system enhances quick payroll processing	4.11	4	5	1.06	1538

Effectiveness and Efficiency of BAS

The biometric attendance system was perceived as highly effective and efficient. The highest mean score was

reported for the accuracy of information generated by the system (mean = 4.20). Lower, though still positive, ratings were observed for ease of accessibility and perceived data security.

Association Between BAS and Employee Performance

Regression analysis demonstrated statistically significant associations between BAS adoption, perceived effectiveness and efficiency, and self-reported employee performance ($p < 0.05$). Gender and education level were significantly associated with BAS adoption, while nationality and years of experience were not consistently significant predictors.

The results presented in Table (3) show the internal consistency reliability using Cronbach's alpha for BAS Adoption, BAS Effectiveness & Efficiency, Employee Performance, and Challenges related to BAS Use. The analysis indicated an acceptable to good level of internal consistency across all constructs (Cronbach's $\alpha = 0.85$, 0.88, 0.86, and 0.82, respectively). This demonstrates that the items reliably measure the adoption level of the biometric attendance system, its perceived effectiveness and efficiency, employee performance, and the perceived challenges associated with BAS use.

Table 3: Cronbach's alpha values for each scale

Construct/Scale	No. of Items	Cronbach's α
BAS Adoption	14	0.85
BAS Effectiveness & Efficiency	9	0.88
Employee Performance	11	0.86
Challenges related to BAS Use	10	0.82

The regression results presented in Table (3) include β coefficients, t-values, standard errors (SE), and p-values. BAS adoption was found to be a significant predictor of staff performance ($\beta = 0.42$, SE = 0.08, $t = 5.25$, $p = 0.000$), indicating that higher levels of biometric attendance system adoption are associated with improved employee performance at King Abdulaziz University Hospital (KAUH).

Similarly, BAS effectiveness was also a significant predictor of staff performance ($\beta = 0.41$, SE = 0.07, $t = 5.43$, $p = 0.000$), suggesting that greater system effectiveness contributes to enhanced employee performance.

Gender was included as a control variable in the regression model. The results in Table (3) showed that gender was not a significant predictor of staff performance ($\beta = 0.06$, SE = 0.08, $t = 0.75$, $p = 0.454$). This indicates that there are no statistically significant differences in staff performance between male and female employees after

controlling for BAS effectiveness. Therefore, the non-significant effect of gender emphasizes that biometric attendance systems influence staff performance uniformly across healthcare employees.

In contrast, educational level was found to be a significant predictor of staff performance (β = 0.22, SE = 0.06, t = 3.45, p = 0.001). This may reflect that higher-educated employees possess stronger organizational commitment, better time-management skills, or greater technological adaptability, which enhance their responsiveness to biometric monitoring systems.

Table 4: Regression Result for BAS Adoption, BAS Effectiveness, Gender and Educational Level

Predictor	**P-value**	**t**	**SE**	**β**
BAS Adoption	0.000*	5.25	0.08	0.42
BAS Effectiveness	0.000*	5.43	0.07	0.41
Gender (Control)	.454	0.75	0.08	0.06
Education Level (Control)	0.001	3.45	0.06	0.22

Table 5: Effectiveness and efficiency of BAS

Statistics					**n=374**
	Mean	Median	Mode	SD	Sum
Effectiveness and Efficiency of BAS					
Fingerprint biometric system is relevant to the needs of the hospital	4.09	4.00	4.00	1.02	1531.00
The system has the capacity to resolve attendance issues"	4.12	4.00	5.00	1.07	1542.00
Efficient in the management of attendance"	4.14	4.00	5.00	1.04	1548.00
Reduce the time wastage in recording attendance manually"	4.12	4.00	4.00	1.02	1540.00
Easily accessible to all staff	3.88	4.00	4.00	1.08	1450.00
The accuracy of the value of the information generated by the device is high"	4.20	4.00	5.00	1.04	1571.00
The biometric attendance system is considered a reliable method in the management of staff attendants	4.03	4.00	4.00	1.09	1507.00
The system is secure against hacking threats/privacy breach	3.96	4.00	4.00	1.03	1482.00

The machine is easy to use	4.15	4.00	5.00	1.04	1553.00

Discussion

This study provides empirical evidence that the regression analysis demonstrated that biometric attendance system (BAS) factors play a significant role in predicting staff performance among healthcare employees at King Abdulaziz University Hospital (KAUH). Specifically, BAS adoption emerged as a strong and statistically significant predictor, indicating that higher levels of employee acceptance and utilization of the biometric system were associated with improved staff performance. Similarly, BAS effectiveness was also found to significantly influence performance, suggesting that when the system functions efficiently and reliably, it enhances employee accountability, punctuality, and overall work outcomes.

Regarding control variables, gender was not found to significantly predict staff performance, indicating that the impact of the biometric attendance system is consistent across male and female employees. This suggests that BAS implementation promotes equitable performance monitoring regardless of gender differences. In contrast, educational level showed a significant positive effect on staff performance, implying that employees with higher educational qualifications may possess better technological adaptability, organizational commitment, and time-management skills, which enhance their responsiveness to biometric monitoring systems.

Regarding healthcare employees' perceptions of a biometric attendance system and its association with self-reported performance at KAUH. The findings indicate high acceptance of the system and positive perceptions of its efficiency, particularly in terms of attendance accuracy and time management.

The observed associations between BAS dimensions and employee performance align with prior studies suggesting that biometric systems may support administrative efficiency and reduce attendance-related errors. However, consistent with the cross-sectional design, these

findings should be interpreted as associations rather than causal effects.

Differences in BAS adoption by gender and education level suggest the need for targeted training and awareness initiatives to ensure equitable system acceptance across employee groups.

Conclusion

Healthcare employees at King Abdulaziz University Hospital reported high levels of adoption and positive perceptions of the biometric attendance system. Significant associations were observed between BAS adoption, perceived effectiveness and efficiency, and self-reported employee performance. The regression findings highlight that both the adoption and effectiveness of biometric attendance systems are key determinants of staff performance in healthcare settings. While educational level may moderate this relationship, gender appears to have no significant influence. While the findings suggest perceived benefits in attendance management and administrative efficiency, causal conclusions cannot be drawn due to the cross-sectional nature of the study.

Recommendations

Healthcare administrators should support biometric attendance system implementation through continuous technical support, staff training, and infrastructure maintenance. Future research should employ longitudinal designs and objective performance indicators to better assess the causal impact of biometric attendance systems on healthcare workforce performance.

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