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RESEARCH ARTICLE

REVISED Impact of a Transformational Leadership Program for Nurse Managers on Nurses' Job Satisfaction and Work Environment in Saudi Arabian Primary Healthcare Centers: A Quasi-Experimental Study

[version 2; peer review: 2 approved]

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Abstract

Abstract*

Background

Transformational leadership has been associated with improved organizational performance and employee well-being. However, evidence on structured transformational leadership program in primary healthcare settings remains limited, particularly in Saudi Arabia. This study evaluated the effectiveness of a transformational leadership program in improving nurses' job satisfaction and perceptions of the work environment in primary healthcare centers in Medina, Saudi Arabia.

Methods

A quasi-experimental pre-test and post-test study with a control group was conducted among 104 nurses working in Ministry of Health primary healthcare centers in Medina, Saudi Arabia. Participants were assigned to an intervention group (n = 52) or a control group (n = 52). The intervention comprised a structured transformational leadership program delivered to nurse managers over two weeks. Job satisfaction was assessed using the Minnesota Satisfaction Questionnaire (MSQ), while the work environment was assessed using the Areas of Worklife Survey (AWS). Within-group changes were examined using paired-samples t-tests, and analysis of covariance

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(ANCOVA) was used to compare post-intervention outcomes between groups after adjustment for baseline scores.

Results

Significant improvements were observed in the intervention group compared with the control group across all study outcomes. After adjustment for baseline scores, ANCOVA demonstrated significant intervention effects on overall job satisfaction (partial $\eta^2 = 0.883$), intrinsic job satisfaction (partial $\eta^2 = 0.910$), extrinsic job satisfaction (partial $\eta^2 = 0.689$), and work environment (partial $\eta^2 = 0.747$) (all $p < 0.001$).

Conclusions

A structured transformational leadership program delivered to nurse managers over two weeks was associated with significant improvements in nurses' job satisfaction and perceptions of the work environment in primary healthcare centers. Leadership development may provide a practical organizational strategy for strengthening nurses' workplace well-being and improving work environments in primary healthcare settings.

Keywords
Transformational leadership, job satisfaction, work environment, primary healthcare, nurses, quasi-experimental study, Saudi Arabia, leadership development.



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REVISED **Amendments from Version 1**

This version of the article has been revised in response to comments from the peer reviewer and editorial team. Major revisions include clarification of the study rationale and research gap, addition of a Literature Review and Hypothesis Development section, and expanded methodological details regarding the intervention, participants, measurement instruments, scoring procedures, and instrument validity. The statistical analysis and reporting have also been strengthened, including reporting of ANCOVA assumption testing and 95% confidence intervals for intervention effects. The Discussion has been revised to provide a more cautious interpretation of the findings and to avoid attributing effects to unmeasured mediating mechanisms. The Data Availability and ethical approval statements have also been clarified.

Any further responses from the reviewers can be found at the end of the article

Introduction

Primary healthcare (PHC) is a cornerstone of healthcare systems, providing accessible, comprehensive, and community-oriented care across the continuum of health services. Nurses constitute a substantial proportion of the healthcare workforce and play central roles in direct patient care, health promotion, disease prevention, patient education, care coordination, and quality improvement. Maintaining a motivated and satisfied nursing workforce and a supportive work environment is therefore important for sustaining healthcare quality and organizational performance.[1,2] In Saudi Arabia, the work environment of nurses in PHC centers is particularly relevant, as a national study involving 519 nurses identified variability in perceptions of staffing and resources and other dimensions of the nursing practice environment.[3]

Job satisfaction is an important indicator of nurses' workplace well-being and organizational functioning. Higher job satisfaction has been associated with greater organizational commitment and intention to remain in the workforce, whereas lower satisfaction has been linked to workforce instability and turnover intention.[2,4] Nurses' job satisfaction is influenced by multiple factors, including leadership, workload, staffing, organizational support, professional development opportunities, workplace relationships, and working conditions.[1,2] Evidence from Saudi Arabian PHC centers also indicates that supervision, communication, and other organizational factors are relevant to healthcare providers' job satisfaction and intention to leave.[9]

Leadership is a potentially modifiable organizational factor that may influence nurses' job satisfaction and work environment. Transformational leadership emphasizes idealised influence, inspirational motivation, intellectual stimulation, and individualized consideration and seeks to motivate staff, encourage professional development, facilitate collaboration, and support organizational change.[5] Previous research has associated transformational leadership with nurses' job satisfaction and positive workplace outcomes. For example, Boamah et al.[6] found that transformational leadership by nurse managers was positively related to workplace empowerment, which in turn was associated with higher nurses' job satisfaction and more favourable patient safety outcomes. Systematic review evidence has likewise indicated that transformational leadership can positively influence nurses' work environments, with job satisfaction, organizational commitment, and empowerment acting as important pathways.[7]

The relationship between nurse managers' leadership and staff nurses' outcomes is particularly relevant because nurse managers directly influence nurses' daily working conditions, communication, support, and opportunities for participation. Uslu Sahan and Terzioglu,[8] for example, found that transformational leadership practices of nurse managers were associated with staff nurses' job satisfaction and organizational commitment in a study involving 17 nurse managers and 136 staff nurses. However, this evidence was observational and therefore could not determine whether developing transformational leadership capabilities among nurse managers leads to subsequent improvements in staff nurses' workplace outcomes. Recent intervention research has demonstrated that leadership development programs can improve the leadership knowledge and practices of nurse leaders. Emam et al.,[10] for example, reported significant improvements in leadership knowledge and practices following a six-week leadership development program for head nurses. However, it remains unclear whether a structured transformational leadership program delivered to nurse managers can translate into measurable improvements in staff nurses' intrinsic and extrinsic job satisfaction, overall job satisfaction, and perceptions of the work environment, particularly in primary healthcare settings. The present study addresses this gap by evaluating a structured transformational leadership program for nurse managers using a quasi-experimental pre-test/post-test design with a control group and by assessing multiple staff-nurse-reported workplace outcomes.

This gap is particularly relevant in Saudi Arabia, where ongoing healthcare reforms under Saudi Vision 2030 emphasize healthcare quality, patient-centered care, workforce development, and organizational performance. PHC centers represent an important setting for these reforms, and evidence from Eastern Saudi Arabia has highlighted the importance of organizational factors, including supervision and communication, for healthcare providers' satisfaction.[9] Developing

nurse managers' leadership capabilities may therefore represent a potentially useful organizational strategy for strengthening nurses' workplace experiences. Although transformational leadership has been examined among Saudi nursing leaders and supervisors, it remains uncertain whether a structured transformational leadership intervention for nurse managers can improve staff nurses' job satisfaction and perceptions of the work environment in Saudi Arabian PHC settings.[4,10]

Accordingly, this study aimed to determine whether a structured transformational leadership program delivered to nurse managers was associated with improvements in staff nurses' job satisfaction and perceptions of the work environment in primary healthcare centers in Medina, Saudi Arabia, compared with usual leadership practice. The study specifically assessed changes in overall, intrinsic, and extrinsic job satisfaction and perceptions of the work environment following the intervention.

Literature review and hypothesis development

Transformational leadership is characterized by four core dimensions: idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration. Through these behaviours, transformational leaders seek to motivate followers, encourage professional development, stimulate new ways of thinking, and promote commitment to shared organizational goals.[5] In nursing settings, these leadership behaviours may influence nurses' experiences of their work by strengthening support, communication, empowerment, and opportunities for professional development. Previous research has reported positive relationships between transformational leadership and nurses' job satisfaction. Boamah et al.,[6] for example, found that transformational leadership was positively associated with workplace empowerment and nurses' job satisfaction. An integrative review by Gebreheat et al.[12] similarly identified transformational leadership as an important leadership approach associated with improved nurses' job satisfaction.

The nursing work environment is another important organizational outcome that may be influenced by leadership practices. A positive work environment includes supportive management, effective communication, adequate resources, constructive workplace relationships, recognition, and opportunities for participation in organizational decision-making. Transformational leaders may contribute to these conditions by encouraging collaboration, supporting staff development, and promoting participation and shared goals. A systematic review by Ystaas et al.[7] found that transformational leadership was positively associated with the nursing work environment and several related organizational and patient outcomes. These findings suggest that leadership practices may be relevant not only to individual job satisfaction but also to nurses' perceptions of the broader environment in which they work.

Nurse managers occupy an important position in translating leadership practices into nurses' daily work experiences because they have direct responsibilities for staff supervision, communication, coordination, and support. Consequently, leadership development programmes targeting nurse managers may provide a practical organizational strategy for improving nurses' workplace outcomes. Evidence from intervention research indicates that structured leadership development can improve leadership-related outcomes among nurse leaders. Emam et al.,[10] for example, reported significant improvements in leadership knowledge and practices following a six-week leadership development programme for head nurses. However, improvements in nurse managers' leadership knowledge or practices do not necessarily demonstrate corresponding improvements in staff nurses' outcomes. Whether a structured transformational leadership programme delivered specifically to nurse managers can improve staff nurses' job satisfaction and perceptions of their work environment therefore remains insufficiently established.

This issue is particularly relevant in Saudi Arabian primary healthcare settings. Previous research in Saudi Arabia has identified relationships between leadership and nurses' satisfaction and intention to remain in the workforce,[4] while more recent research has examined transformational leadership capacities among nurse supervisors.[11] However, these studies do not establish whether a structured transformational leadership programme can improve staff nurses' workplace outcomes. Evidence from intervention-based research in Saudi Arabian PHC settings remains limited, particularly regarding programmes delivered to nurse managers and evaluated using nurse-reported outcomes. The present study therefore addresses an important evidence gap by examining whether a structured transformational leadership programme for nurse managers is associated with improvements in staff nurses' overall, intrinsic, and extrinsic job satisfaction and perceptions of the work environment.

Hypothesis development

Based on transformational leadership theory and the empirical evidence described above, transformational leadership development is expected to improve nurses' workplace experiences by strengthening leadership practices that support

communication, collaboration, professional development, and a favourable work environment.[5–7] Accordingly, the following hypothesis was formulated:

H1: Nurses in primary healthcare centres whose nurse managers participate in a structured transformational leadership programme will have higher post-intervention overall job satisfaction, intrinsic job satisfaction, extrinsic job satisfaction, and work environment scores than nurses in the control group, after adjustment for baseline scores.

Methods

Study design and setting

This quasi-experimental study employed a pre-test and post-test control group design to evaluate the effectiveness of a structured transformational leadership program delivered to nurse managers on staff nurses' job satisfaction and perceptions of the work environment. The study was conducted in seven government-operated Ministry of Health primary healthcare centers (PHCs) in Medina, Saudi Arabia. The participating PHCs were Al-Hijrah Health Center, Wa'irah Health Center, Al-Safiyyah Health Center, the Health Surveillance Center at Prince Mohammed bin Abdulaziz International Airport, Al-Daithah Health Center, Bab Jibreel Health Center, and Al-Salsalah Health Center. Four PHCs comprised the intervention group and three comprised the control group. The intervention was delivered to nurse managers in the intervention PHCs, while outcomes were assessed among staff nurses working under their supervision.

Participants and sample size

The target population comprised registered nurses employed at the seven participating PHCs, with a total population of 142 nurses. The required sample size was calculated using a 95% confidence level and a 5% margin of error for the finite study population, resulting in a required sample of 104 nurses. Convenience non-probability sampling was used to recruit eligible participants until the required sample size was achieved. A total of 104 nurses were included in the study, with 52 nurses in the intervention group and 52 in the control group. The transformational leadership programme was delivered to 52 nurse managers in the intervention PHCs. All participants completed both the pre-intervention and post-intervention assessments and were included in the final analysis. Eligible participants were registered nurses employed at one of the participating PHCs who provided written informed consent. Non-nursing staff and nurses who declined to provide informed consent were excluded.

The 104 nurses were recruited from seven participating PHCs. The intervention group comprised nurses from Al-Hijrah (n = 16), Wairah (n = 11), Al-Safiyyah (n = 13), and the Health Surveillance Center (n = 12), while the control group comprised nurses from Al-Daithah (n = 13), Bab Jibreel (n = 14), and Al-Salsalah (n = 15). The nurse managers who received the intervention were not included in the outcome analysis, and their individual demographic and professional characteristics were not recorded in the available study dataset. Therefore, manager-level characteristics could not be reported retrospectively. The number of nurses supervised by each nurse manager could not be determined retrospectively because individual nurse–manager linkages were not recorded in the available study records.

Intervention and control conditions

The intervention group comprised four PHCs: Al-Hijrah Health Center, Wa'irah Health Center, Al-Safiyyah Health Center, and the Health Surveillance Center at Prince Mohammed bin Abdulaziz International Airport. The control group comprised three PHCs: Al-Daithah Health Center, Bab Jibreel Health Center, and Al-Salsalah Health Center. Nurse managers in the intervention PHCs received the transformational leadership program, whereas nurse managers in the control PHCs continued their routine leadership practices during the study period.

Transformational leadership program

The transformational leadership program was developed to strengthen nurse managers' leadership competencies and their ability to foster supportive workplace relationships, effective communication, team motivation, and a positive organizational climate. The program was based on the four core dimensions of transformational leadership: idealised influence, inspirational motivation, intellectual stimulation, and individualized consideration.

The program was delivered over two weeks and comprised five training days, with two training days during the first week and three during the second week. Each training session lasted approximately three hours. The program combined interactive lectures, facilitated group discussions, case-based learning, role-playing exercises, leadership simulations, and practical problem-solving activities. The training covered transformational leadership principles, effective communication, team motivation, conflict management, ethical leadership, decision-making, and strategies for improving workplace collaboration. Practical activities enabled nurse managers to apply transformational leadership behaviours to realistic situations encountered in primary healthcare practice.

Program evaluation included a pre-training assessment before the intervention and a post-training assessment at program completion. Participants also completed a program evaluation form and received certificates of completion. Structured observational checklists were used during practical leadership exercises to assess leadership behaviours. Following completion of the program, weekly unannounced observational visits were conducted for six months to monitor the application of transformational leadership behaviours in routine managerial practice.

Outcome measures

The primary study outcomes were nurses' job satisfaction and perceptions of the work environment. Outcomes were assessed using standardised self-administered questionnaires administered before the intervention and after completion of the two-week program.

Job satisfaction

Job satisfaction was assessed using a 20-item questionnaire based on the short-form Minnesota Satisfaction Questionnaire (MSQ). The questionnaire used in this study comprised 12 items assessing intrinsic job satisfaction and 8 items assessing extrinsic job satisfaction. Each item was rated on a five-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). Scores for the intrinsic job satisfaction domain were calculated by summing the 12 corresponding items, resulting in a possible score range of 12–60. Scores for the extrinsic job satisfaction domain were calculated by summing the 8 corresponding items, resulting in a possible score range of 8–40. Overall job satisfaction was calculated by summing all 20 items, resulting in a possible score range of 20–100. Higher scores indicated greater job satisfaction. The questionnaire used in this study is provided as extended data.

Work environment

Work environment was assessed using 11 items adapted from the Areas of Worklife Survey (AWS), covering six domains: workload, control, reward, community, fairness, and values. Each item was rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The work environment score was calculated by summing the scores of the 11 items, resulting in a possible total score ranging from 11 to 55, with higher scores indicating more favourable perceptions of the work environment. The full set of items used in the study is provided as extended data.

Questionnaire pre-testing, validity and reliability

The questionnaire was pilot-tested among 25 nurses at Al-Hijrah PHC before the main study to assess the clarity and comprehensibility of the items. Content validity was assessed by a panel of experts using the item-level content validity index (I-CVI). The I-CVI values ranged from 0.83 to 0.94 across the questionnaire items, indicating acceptable content validity. Internal consistency was assessed using Cronbach's alpha, with a coefficient greater than 0.70 considered acceptable. The MSQ was selected because of its established validity and reliability and its previous use in healthcare settings, including Saudi Arabia.

Data collection procedures

Before data collection, eligible nurses were informed about the study objectives, procedures, voluntary nature of participation, and confidentiality of the information collected. The study procedures and questionnaire administration were conducted online. Eligible nurses received the study information and an electronic informed consent form before completing the online questionnaire. Only nurses who provided informed consent were enrolled in the study. Baseline questionnaires were completed online by nurses in both intervention and control PHCs before nurse managers in the intervention group participated in the transformational leadership program.

Following completion of the two-week intervention, the same outcome measures were administered online to assess post-intervention changes in nurses' job satisfaction and perceptions of the work environment. The same standardized online questionnaire administration procedures were used for participants from all participating PHCs.

Weekly unannounced observational visits were subsequently conducted for six months to monitor the implementation of transformational leadership behaviours among nurse managers in the intervention group. These observations were used to monitor intervention implementation and were not the primary assessment of nurses' job satisfaction or work environment.

Strategies to minimise bias

Several procedures were used to promote consistency in intervention implementation and outcome assessment. The same outcome measures were administered before and after the intervention, and standardized questionnaire administration procedures were applied across participating PHCs. Participation was voluntary, written informed consent was obtained, and confidentiality of participant responses was maintained. The control group continued routine leadership practices

Table 1. **Participant characteristics of the study population (n = 104).**

Characteristic	n (%)
Age (years)	
18–25	19 (18.3)
26–35	27 (26.0)
36–45	31 (29.8)
46–55	20 (19.2)
≥56	7 (6.7)
Gender	
Male	47 (45.2)
Female	57 (54.8)
Nationality	
Saudi	96 (92.3)
Non-Saudi	8 (7.7)
Marital status	
Single	22 (21.2)
Married	52 (50.0)
Divorced	19 (18.3)
Separated	4 (3.8)
Widowed	7 (6.7)
Educational level	
Diploma	39 (37.5)
Bachelor's degree	50 (48.1)
Master's degree	14 (13.5)
PhD	1 (1.0)
Professional experience	
<1 year	10 (9.6)
1–5 years	25 (24.0)
6–10 years	22 (21.2)
11–20 years	23 (22.1)
>20 years	24 (23.1)
Role in household	
Head of household	31 (29.8)
Breadwinner	73 (70.2)
Monthly income (SAR)	
0–19,999	58 (55.8)
20,000–30,000	30 (28.8)
30,000	16 (15.4)
PHC operating hours	
8 am–11 pm	27 (26.0)
24 hours	77 (74.0)

Table 2. **Baseline comparison of study outcomes between intervention and control groups.**

Outcome	Intervention Mean ± SD	Control Mean ± SD	*t*	*p* value
Overall job satisfaction	56.40 ± 13.79	49.50 ± 10.35	2.887	0.005
Intrinsic job satisfaction	32.60 ± 9.34	28.44 ± 6.67	2.611	0.010
Extrinsic job satisfaction	23.81 ± 5.39	21.06 ± 4.62	2.791	0.006
Work environment	36.48 ± 8.47	32.33 ± 9.02	2.421	0.017

Table 3. **Changes in study outcomes before and after the intervention.**

Outcome	Group	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	*t*	*p* value	Cohen's *d*
Intrinsic job satisfaction	Intervention	32.60 ± 9.34	57.23 ± 1.72	24.63	−19.934	<0.001	−2.764
	Control	28.44 ± 6.67	27.90 ± 6.08	0.54	0.402	0.689	0.056
Extrinsic job satisfaction	Intervention	23.81 ± 5.39	38.06 ± 1.18	14.25	−18.837	<0.001	−2.612
	Control	21.06 ± 4.62	21.33 ± 7.58	−0.27	−0.225	0.823	−0.031
Work environment	Intervention	36.48 ± 8.47	52.63 ± 1.72	16.15	−13.779	<0.001	−1.911
	Control	32.33 ± 9.02	32.50 ± 7.88	−0.17	−0.112	0.911	−0.016
Overall job satisfaction	Intervention	56.40 ± 13.79	95.29 ± 2.46	38.88	−20.719	<0.001	−2.873
	Control	49.50 ± 10.35	49.23 ± 11.29	0.27	0.121	0.904	0.017

Table 4. **ANCOVA results comparing post-intervention outcomes after adjustment for baseline scores.**

Outcome	Adjusted mean (Intervention)	Adjusted mean (Control)	Adjusted mean difference (95% CI)	*F*	*p* value	Partial η^2
Overall job satisfaction	95.170	48.882	**46.288 (42.96-49.62)**	759.851	<0.001	0.883
Intrinsic job satisfaction	57.231	27.904	**29.327 (27.50-31.15)**	1016.011	<0.001	0.910
Extrinsic job satisfaction	37.984	21.401	**16.583 (14.39-18.78)**	224.017	<0.001	0.689
Work environment	52.480	32.654	**19.826 (17.55-22.10)**	298.502	<0.001	0.747

Table 5. **Pearson correlation matrix among study variables.**

Variable	Intrinsic job satisfaction	Extrinsic job satisfaction	Work environment	Overall job satisfaction
Intrinsic job satisfaction	1.000	0.726	0.750	0.959
Extrinsic job satisfaction	0.726	1.000	0.742	0.891
Work environment	0.750	0.742	1.000	0.801
Overall job satisfaction	0.959	0.891	0.801	1.000

Table 6. **Association between participant characteristics and overall job satisfaction.**

Participant characteristic	Statistical test	Test statistic	*p* value	Interpretation
Gender	Independent-samples *t*-test	$t = -1.217$	0.227	Not significant
Age	One-way ANOVA	$F = 1.38$	0.246	Not significant
Educational level	One-way ANOVA	$F = 12.39$	<0.001	Significant
Professional experience	One-way ANOVA	$F = 2.04$	0.094	Not significant

during the study period, providing a comparison condition for assessing changes over time. Weekly unannounced observational visits were used to monitor the implementation of the intervention following training.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 20.0. Descriptive statistics were used to summarise participant characteristics and study variables. Continuous variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages.

Independent-samples *t*-tests were used to compare continuous study outcomes between the intervention and control groups at baseline. Paired-samples *t*-tests were used to assess changes in overall job satisfaction, intrinsic job satisfaction, extrinsic job satisfaction, and work environment from pre-intervention to post-intervention within each group. Cohen's *d* was calculated to quantify the magnitude of within-group changes.

Because significant baseline differences were observed between the intervention and control groups for overall, intrinsic, and extrinsic job satisfaction, as well as work environment, ANCOVA was used as the primary comparative analysis to compare post-intervention outcomes between groups while adjusting for the corresponding baseline scores. Before conducting ANCOVA, the assumption of homogeneity of regression slopes was assessed by testing the interaction between group and the corresponding baseline outcome score. The assumption was considered satisfied when the interaction term was not statistically significant ($p > 0.05$). Adjusted means, F statistics, p values, and partial eta squared (partial η^2) were reported as measures of intervention effect and effect size.

Pearson correlation analysis was conducted to examine the relationships among intrinsic job satisfaction, extrinsic job satisfaction, work environment, and overall job satisfaction. Associations between participant characteristics and overall job satisfaction were examined using independent-samples *t*-tests for categorical variables with two groups and one-way analysis of variance (ANOVA) for variables with more than two groups. All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant.

Results

Participant characteristics

A total of 104 registered nurses participated in the study, comprising 52 nurses in the intervention group and 52 in the control group. All participants completed both the pre-intervention and post-intervention assessments and were included in the final analysis. Participant characteristics are presented in Table 1.

The largest proportion of participants was aged 36–45 years (31/104, 29.8%), followed by those aged 26–35 years (27/104, 26.0%). More than half of the participants were female (57/104, 54.8%), Saudi nationals (96/104, 92.3%), and married (52/104, 50.0%). Regarding educational attainment, 50 participants (48.1%) held a bachelor's degree and 39 (37.5%) held a diploma. Professional experience varied, with 24 participants (23.1%) reporting more than 20 years of experience.

Baseline comparison between intervention and control groups

Baseline study outcomes are presented in Table 2. Significant differences were observed between the intervention and control groups for all four study outcomes. The intervention group had higher baseline overall job satisfaction than the control group (56.40 ± 13.79 vs. 49.50 ± 10.35; $t = 2.887$, $p = 0.005$). Intrinsic job satisfaction was also higher in the intervention group (32.60 ± 9.34 vs. 28.44 ± 6.67; $t = 2.611$, $p = 0.010$), as was extrinsic job satisfaction (23.81 ± 5.39 vs. 21.06 ± 4.62; $t = 2.791$, $p = 0.006$). Work environment scores were likewise higher in the intervention group than in the control group (36.48 ± 8.47 vs. 32.33 ± 9.02; $t = 2.421$, $p = 0.017$). These baseline differences were taken into account in the subsequent ANCOVA analyses.

Changes in study outcomes following the intervention

Changes in study outcomes from pre-intervention to post-intervention are presented in Table 3. In the intervention group, significant improvements were observed in all four outcomes. Intrinsic job satisfaction increased from 32.60 ± 9.34 at baseline to 57.23 ± 1.72 after the intervention (mean difference = 24.63; $t = -19.934$, $p < 0.001$; Cohen's $d = 2.764$). Extrinsic job satisfaction increased from 23.81 ± 5.39 to 38.06 ± 1.18 (mean difference = 14.25; $t = -18.837$, $p < 0.001$; Cohen's $d = 2.612$).

Work environment scores increased from 36.48 ± 8.47 to 52.63 ± 1.72 (mean difference = 16.15; $t = -13.779$, $p < 0.001$; Cohen's $d = 1.911$). Overall job satisfaction increased from 56.40 ± 13.79 to 95.29 ± 2.46 (mean difference = 38.88; $t = -20.719$, $p < 0.001$; Cohen's $d = 2.873$). In the control group, no statistically significant changes were observed in

intrinsic job satisfaction ($p = 0.689$), extrinsic job satisfaction ($p = 0.823$), work environment ($p = 0.911$), or overall job satisfaction ($p = 0.904$). Effect sizes were negligible across all four outcomes.

Adjusted intervention effects

Because significant baseline differences were observed for all four study outcomes, ANCOVA was used to compare post-intervention outcomes between the intervention and control groups after adjustment for baseline scores. The assumption of homogeneity of regression slopes was met for all outcomes. The group-by-baseline interaction was not statistically significant for overall job satisfaction ($F = 0.948$, $p = 0.333$), intrinsic job satisfaction ($F = 2.931$, $p = 0.090$), extrinsic job satisfaction ($F = 0.200$, $p = 0.656$), or work environment ($F = 0.569$, $p = 0.452$). The results are presented in Table 4. After adjustment for baseline scores, the intervention group had significantly higher post-intervention scores than the control group for overall job satisfaction, intrinsic job satisfaction, extrinsic job satisfaction, and work environment (all $p < 0.001$).

The adjusted mean for overall job satisfaction was 95.170 in the intervention group and 48.882 in the control group, corresponding to an adjusted mean difference of 46.288 (95% CI: 42.96–49.62; $F = 759.851$, $p < 0.001$, partial $\eta^2 = 0.883$). For intrinsic job satisfaction, the adjusted mean difference was 29.327 (95% CI: 27.50–31.15; $F = 1016.011$, $p < 0.001$, partial $\eta^2 = 0.910$). For extrinsic job satisfaction, the adjusted mean difference was 16.583 (95% CI: 14.39–18.78; $F = 224.017$, $p < 0.001$, partial $\eta^2 = 0.689$). For work environment, the adjusted mean difference was 19.826 (95% CI: 17.55–22.10; $F = 298.502$, $p < 0.001$, partial $\eta^2 = 0.747$).

Correlations among study variables

Pearson correlation coefficients are presented in Table 5. Significant positive correlations were observed among all study variables (all $p < 0.001$). Overall job satisfaction demonstrated a strong positive correlation with intrinsic job satisfaction ($r = 0.959$), extrinsic job satisfaction ($r = 0.891$), and work environment ($r = 0.801$). Intrinsic job satisfaction was also positively correlated with extrinsic job satisfaction ($r = 0.726$) and work environment ($r = 0.750$). Extrinsic job satisfaction was positively correlated with work environment ($r = 0.742$).

Associations between participant characteristics and overall job satisfaction

Associations between selected participant characteristics and overall job satisfaction are presented in Table 6. Educational level was significantly associated with overall job satisfaction ($F = 12.39$, $p < 0.001$). No statistically significant associations were observed for gender ($t = -1.217$, $p = 0.227$), age ($F = 1.38$, $p = 0.246$), or professional experience ($F = 2.04$, $p = 0.094$).

Discussion

This study evaluated whether a structured transformational leadership program delivered to nurse managers was associated with improvements in staff nurses' job satisfaction and perceptions of the work environment in primary healthcare centers in Medina, Saudi Arabia. The intervention group showed significant pre- to post-intervention improvements in overall, intrinsic, and extrinsic job satisfaction and work environment, whereas no significant changes were observed in the control group. Importantly, significant baseline differences were present between the intervention and control groups for all four outcomes. After adjustment for baseline scores using ANCOVA, the intervention group continued to demonstrate substantially higher post-intervention scores across all outcomes. These findings provide intervention-based evidence supporting the potential value of transformational leadership development for nurse managers in primary healthcare settings.

The findings are broadly consistent with previous evidence linking transformational leadership with nurses' job satisfaction and positive workplace outcomes. Gebreheat et al.,[12] in an integrative review, identified a consistent positive relationship between transformational leadership and nurses' job satisfaction. Similarly, Ystaas et al.[7] reported that transformational leadership was associated with more favourable nursing work environments and identified job satisfaction, organizational commitment, and empowerment as important outcomes associated with transformational leadership. The present findings extend this literature by examining a structured leadership intervention rather than relying solely on nurses' perceptions of existing leadership practices. The results are also consistent with evidence that leadership development programs can strengthen leadership practices among nurse leaders.[12]

The improvement in overall job satisfaction observed in the intervention group is consistent with the broader theoretical framework of transformational leadership. Transformational leadership emphasizes inspirational motivation, individualized consideration, intellectual stimulation, and idealised influence.[5] These leadership dimensions may be relevant to nurses' workplace experiences; however, the present study did not directly measure specific mechanisms such as communication, recognition, participation, professional development, or shared problem-solving.[5] These leadership

behaviours are particularly relevant in primary healthcare settings, where nurse managers are responsible for coordinating staff, supporting teamwork, responding to workplace challenges, and maintaining effective day-to-day communication. Previous research has shown that transformational leadership practices among nurse managers are associated with staff nurses' job satisfaction and organizational commitment.[8] The present study adds to this evidence by suggesting that structured development of transformational leadership competencies among nurse managers may be accompanied by improvements in staff nurses' workplace outcomes.

Intrinsic job satisfaction demonstrated the largest adjusted intervention effect, with a partial η^2 of 0.910. This finding suggests that the intervention was particularly strongly associated with aspects of satisfaction related to the intrinsic experience of work. Transformational leadership emphasizes inspirational motivation, individualized consideration, intellectual stimulation, and idealised influence.[5] These leadership dimensions may be relevant to nurses' workplace experiences; however, the present study did not directly measure specific mechanisms through which the intervention may have influenced job satisfaction. However, the present design does not allow us to determine whether improvements in intrinsic satisfaction preceded or caused changes in extrinsic satisfaction or other workplace outcomes. The large effect should therefore be interpreted as an observed adjusted group difference rather than evidence of a specific causal pathway. This interpretation is consistent with previous literature linking transformational leadership with nurses' job satisfaction and professional development.[11,13]

The intervention was also associated with substantial improvements in extrinsic job satisfaction and perceptions of the work environment. This finding is particularly relevant because the work environment represents an important organizational context in which nurses experience workload, control, rewards, relationships, fairness, and shared values. Evidence from Saudi Arabian primary healthcare settings has highlighted the importance of organizational factors for healthcare providers' satisfaction, while research among Saudi nurses has also identified leadership as an important factor associated with satisfaction and intention to remain in the organisation.[4,9] In addition, research examining nursing practice environments in Saudi Arabian PHC centers indicates the importance of organizational conditions and adequate support for nurses' workplace experiences.[3] The present findings therefore suggest that leadership development may be relevant not only to individual attitudes toward work but also to perceptions of the broader work environment.

The strong positive correlations observed among intrinsic job satisfaction, extrinsic job satisfaction, overall job satisfaction, and work environment are also consistent with the interconnected nature of nurses' workplace experiences. However, these correlations should be interpreted as associations rather than evidence that improvement in one construct causes improvement in another. The particularly strong correlations between overall job satisfaction and its intrinsic and extrinsic components are also expected because these dimensions contribute directly to the overall satisfaction construct. Therefore, the correlation findings provide supportive descriptive evidence of the relationships among the study variables but should not be interpreted as evidence of mediation or causal mechanisms.

Educational level was the only participant characteristic significantly associated with overall job satisfaction, whereas gender, age, and professional experience were not significantly associated with job satisfaction. Although this finding may indicate that educational background is relevant to nurses' workplace experiences, it should be interpreted cautiously because the analysis was exploratory and the study was not specifically powered to examine demographic predictors of job satisfaction. The absence of significant associations for the other characteristics does not establish that these factors have no influence on job satisfaction. Rather, the findings suggest that the observed intervention effects were not readily explained by several commonly examined demographic characteristics.

Strengths and limitations

This study has several strengths. First, the quasi-experimental pre-test and post-test control group design allowed changes over time to be examined in both intervention and control groups. Second, the study evaluated both job satisfaction and work environment, providing a broader assessment of nurses' workplace outcomes than studies examining a single outcome. Third, baseline differences between groups were explicitly assessed and statistically addressed using ANCOVA. Fourth, the intervention was structured, delivered over a defined two-week period, and included multiple educational approaches rather than relying solely on didactic instruction. The subsequent observational monitoring of leadership behaviours over six months also provided an additional mechanism for assessing implementation of the program.

Several limitations should nevertheless be considered. First, the study was conducted in PHCs within a single geographic region of Saudi Arabia, which may limit the transferability of the findings to other regions, healthcare organizations, or countries. Second, the study used convenience non-probability sampling and the participating PHCs were not randomly allocated to intervention and control conditions. Consequently, selection bias and residual confounding cannot be

excluded, particularly given the significant baseline differences observed across all four outcomes. Although ANCOVA was used to adjust for baseline scores, statistical adjustment cannot fully substitute for random allocation.

Third, the intervention was delivered to nurse managers at the PHC level, whereas the primary outcomes were measured among individual staff nurses. Thus, participants were situated within organizational and managerial clusters. The present analyses did not explicitly model clustering at the PHC or nurse-manager level, which may affect the precision of standard errors and statistical significance. Future studies should consider cluster-randomized designs or multilevel analytical approaches when the intervention is delivered at the managerial or facility level.

Fourth, the primary outcomes were based on self-reported questionnaires and may therefore have been influenced by response or social desirability bias. Blinding participants to intervention status was also not feasible given the nature of the leadership program. Finally, although observational follow-up of leadership behaviours continued for six months, the primary nurse outcomes were assessed immediately following the intervention. Therefore, the study cannot determine whether the observed improvements in job satisfaction and work environment were sustained over the longer term. In addition, the study did not assess potential mechanisms through which transformational leadership may influence nurses' job satisfaction or work environment. Therefore, the findings do not establish specific causal pathways underlying the observed intervention effects.

Implications for practice

The findings have practical implications for nursing management and primary healthcare organizations. Structured transformational leadership development may be incorporated into professional development programs for nurse managers, particularly in settings undergoing organizational or health-system transformation. Rather than focusing exclusively on clinical competencies, leadership development can include communication, staff motivation, conflict management, ethical decision-making, teamwork, professional development, and individualized support for nurses.

For healthcare organizations in Saudi Arabia, such programs may complement broader workforce and quality-improvement initiatives under Saudi Vision 2030. However, leadership training should not be considered a substitute for addressing structural determinants of nurses' work experiences, such as staffing, workload, resources, remuneration, and organizational policies. Leadership development is more likely to be effective when supported by an organizational environment that enables nurse managers to apply the behaviours acquired through training.

Recommendations for further research

Future studies should use larger samples across multiple regions and healthcare organizations in Saudi Arabia to improve generalisability. Randomized or cluster-randomized designs would provide stronger evidence regarding the causal effects of transformational leadership programs. Because the intervention was implemented at the nurse-manager or PHC level, future studies should also use multilevel analytical approaches that account for clustering of nurses within managers and healthcare facilities.

Longer follow-up periods are needed to determine whether improvements in job satisfaction and work environment are sustained beyond the immediate post-intervention period. Future research could also examine potential mechanisms through which transformational leadership affects nurses' outcomes, including psychological empowerment, work engagement, organizational commitment, perceived organizational support, and burnout. Qualitative research could further explore how nurses experience changes in managerial behaviours following leadership development programs and which components of the intervention are most influential.

Conclusion

This study found that a structured transformational leadership program delivered to nurse managers was associated with significant improvements in staff nurses' overall, intrinsic, and extrinsic job satisfaction and perceptions of the work environment in primary healthcare centers in Medina, Saudi Arabia. These differences remained significant after adjustment for baseline scores, supporting the potential effectiveness of transformational leadership development as an organizational strategy for improving nurses' workplace experiences. However, the non-randomized design, convenience sampling, single-region setting, and reliance on self-reported outcomes warrant cautious interpretation of the findings. Integrating structured transformational leadership development into nurse manager training may provide a practical approach to strengthening supportive work environments and nurses' workplace well-being in primary healthcare settings. Future multicenter studies using randomized or cluster-randomized designs and longer follow-up are needed to assess the effectiveness and sustainability of these effects.

Ethical considerations

Ethical approval for this study was obtained from the Institutional Review Board (IRB), General Directorate of Health Affairs in Madinah, Ministry of Health, Saudi Arabia (National Registration Number with NCBE-KACST, KSA: H-03-M-84; IRB Log No. 25–082). The study received expedited ethical approval on 24 September 2025, prior to participant recruitment. The study procedures, including online data collection, informed consent process, data collection tool, and questionnaire, were conducted in accordance with the IRB-approved research protocol.

Data availability

Underlying data

The individual-level dataset underlying the results of this study is not publicly available because it contains demographic and occupational information collected from nurses participating in the study. Although direct personal identifiers have been removed, the combination of participant characteristics may present a risk of re-identification.

The Institutional Review Board (IRB) approval explicitly requires that personally identifiable participant data must not be disclosed to any other party, that study data must be securely maintained for at least three years after completion of the study, and that the collected data should only be used for this research. Therefore, the participant-level dataset has not been deposited in a public repository.

Requests for access to appropriately de-identified data may be submitted to the corresponding author at alrashidinasserayidhm@gmail.com. Requests should include the proposed purpose of data use and the requester's institutional affiliation. Any request will be reviewed in accordance with the conditions of the ethical approval and applicable institutional requirements. Data will not be released where access would conflict with the ethical approval or participant confidentiality requirements.

Extended data

Figshare: Impact of a Transformational Leadership Programme for Nurse Managers on Nurses' Job Satisfaction and Work Environment in Saudi Arabian Primary Healthcare Centres: A Quasi-Experimental Study: Questionnaire and Programme Training Schedule. https://doi.org/10.6084/m9.figshare.33109133.v1.[14]

This project contains the following extended data:

- Questionnaire. Minnesota Satisfaction Questionnaire (MSQ) and Areas of Worklife Survey (AWS) used for data collection.
- Program Training Schedule. Training schedule and educational materials for the transformational leadership programme.

Data are available under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Citation: Ayidh, M., & Alrashidi Nasser. (2026). Impact of a Transformational Leadership Programme for Nurse Managers on Nurses' Job Satisfaction and Work Environment in Saudi Arabian Primary Healthcare Centres: A Quasi-Experimental Study: Questionnaire and Programme Training Schedule [Dataset]. Figshare. https://doi.org/10.6084/m9.figshare.33109133.v1

Reporting guidelines

Figshare: TREND checklist for "Impact of a Transformational Leadership Program for Nurse Managers on Nurses' Job Satisfaction and Work Environment in Saudi Arabian Primary Healthcare Centers: A Quasi-Experimental Study." https://doi.org/10.6084/m9.figshare.33110084.

Acknowledgements

The authors would like to express their sincere gratitude to Lincoln University College, Malaysia, for its academic support throughout this study. The authors also extend their appreciation to the management and staff of the participating Primary Healthcare Centres in Medina, Saudi Arabia, for facilitating the implementation of this research and to all nurses who generously participated in the study.

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Publisher Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 2

Reviewer Report 21 September 2026

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✔ **Benny Hutahayan**
University of Brawijaya, Malang, East Java, Indonesia

I have reviewed the revised version of the manuscript and appreciate the authors' careful attention to the comments and suggestions provided in the previous review. The authors have adequately addressed the points raised and have made appropriate revisions that improve the clarity, methodological presentation, and overall quality of the manuscript.
The manuscript is now sufficiently clear and well presented, and I have no further major comments. Therefore, I am satisfied with the revisions and recommend the manuscript for approval in its current form.

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Business Administration, Human Resources Management, Law, and Governance

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 01 September 2026

https://doi.org/10.5256/f1000research.208540.r516076

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Suryanti Suryanti
University of Batam, Batam, Indonesia

This manuscript reports a quasi-experimental pre-test/post-test study with a control group evaluating the impact of a structured transformational leadership program delivered to nurse managers on nurses' job satisfaction and perceptions of the work environment in primary healthcare centers in Medina, Saudi Arabia.

The study included 104 nurses from seven Ministry of Health primary healthcare centers, with 52 nurses assigned to the intervention group and 52 to the control group. The intervention consisted of a structured transformational leadership program delivered to nurse managers over two weeks and included interactive lectures, group discussions, case-based learning, role-playing, leadership simulations, and practical problem-solving activities.

Nurses' job satisfaction was assessed using the Minnesota Satisfaction Questionnaire (MSQ), while perceptions of the work environment were assessed using the Areas of Worklife Survey (AWS). The study used pre- and post-intervention assessments, with paired-samples t-tests used to examine within-group changes and ANCOVA used to compare post-intervention outcomes between groups while adjusting for baseline scores.

The study reports significant improvements in overall, intrinsic, and extrinsic job satisfaction and work environment scores in the intervention group. The adjusted ANCOVA analyses also demonstrated statistically significant differences between the intervention and control groups for all four outcomes, with large reported effect sizes.

Overall, the manuscript addresses a relevant topic in nursing management and primary healthcare. The study is clearly presented, the research question is appropriate, the methodology is sufficiently described, and the conclusions are generally consistent with the reported findings. The authors also acknowledge the principal methodological limitations of the study, including the non-randomized design, convenience sampling, single-region setting, self-reported outcomes, and the absence of clustering in the statistical analysis.

Overall assessment

I found the manuscript to be clearly written and logically structured. The introduction provides an appropriate rationale for examining transformational leadership as an organizational intervention, and the literature cited provides relevant background on transformational leadership, nurses' job satisfaction, and the nursing work environment. The manuscript also includes recent literature, including systematic and integrative reviews and recent intervention research.
The study design is appropriate for the research question. Although the study is not randomized, the inclusion of a control group and pre-intervention measurements provides a useful basis for assessing changes associated with the intervention. The authors appropriately identified baseline differences between the intervention and control groups and incorporated baseline scores into the subsequent ANCOVA analyses.

The description of the intervention is also a strength. The manuscript specifies the duration, training structure, content, and educational approaches used in the transformational leadership

program. The availability of the questionnaire and programme training schedule as extended data further supports transparency and reproducibility.

The results are presented clearly in Tables 1–6, and the discussion appropriately relates the findings to previous literature. Importantly, the authors do not appear to overstate the findings in the discussion. They explicitly recognize that the study design does not allow specific causal pathways to be established and appropriately interpret the correlation analyses as associations rather than causal relationships.

The limitations are also appropriately acknowledged. In particular, the authors recognize that the participating PHCs were not randomly allocated, convenience sampling was used, and the study was conducted in a single geographic region. They also explicitly acknowledge that nurses were clustered within PHCs/nurse managers and that clustering was not incorporated into the present statistical analyses.
Statistical analysis

I am not qualified to provide a definitive assessment of the statistical analysis and therefore recommend that the statistical component of the manuscript be reviewed by a qualified statistician.

In particular, statistical review would be useful because the intervention was delivered at the nurse-manager/primary healthcare center level, whereas the outcomes were measured at the individual nurse level. Consequently, observations may be clustered within healthcare centers and nurse managers. The authors have appropriately recognized this issue as a limitation and recommend multilevel analytical approaches or cluster-randomized designs in future research.

A qualified statistician may therefore wish to verify the appropriateness of the analytical approach, including the ANCOVA model, assumptions underlying the analyses, and the reported effect sizes and significance levels in view of the hierarchical structure of the data.

This point is raised as a recommendation for statistical verification rather than as a conclusion that the reported findings are invalid. The remaining methodological and interpretative aspects of the manuscript appear reasonable based on the information provided.

Data availability and reproducibility

The manuscript provides an appropriate explanation for why individual-level data are not publicly deposited, citing participant confidentiality and the requirements of the relevant ethical approval. The authors nevertheless provide a mechanism for requesting appropriately de-identified data, subject to ethical and institutional requirements.

The extended data also include the questionnaires and the programme training schedule, which are useful for understanding and reproducing the intervention and outcome assessment procedures.

Conclusions

The conclusions are adequately supported by the results presented. The intervention group

showed improvements in all four assessed outcomes, and the differences remained statistically significant after adjustment for baseline scores.

The conclusion is appropriately cautious in acknowledging the non-randomized design, convenience sampling, single-region setting, self-reported outcomes, and need for longer-term follow-up.

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Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: healthcare qualitu assurance, patient safety, medical education, public health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 01 September 2026

https://doi.org/10.5256/f1000research.208540.r516077

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Benny Hutahayan

University of Brawijaya, Malang, East Java, Indonesia

The Introduction states that most previous studies were observational or correlational in nature and that evidence from intervention-based studies in Saudi Arabian primary health care (PHC) remains limited. However, this gap is still described in general terms. The authors need to explain more explicitly what remains unknown from previous research and how this study specifically fills that gap.
There is no chapter on literature review and hypothesis development. The authors need to add one.
The manuscript explains that extrinsic satisfaction consists of 6 items on a 1–5 scale, so theoretically the maximum score is 30. However, the study results report a post-intervention average extrinsic satisfaction score of 38.06. The authors need to explain which version of the MSQ was used, the item breakdown, the score range, and the calculation method.
The number of nurse managers who participated in the program, their characteristics, the number of nurses under each manager, and the distribution of participants across each PHC should be reported.
The manuscript should list all items used, the response scale, the scoring method, and the score range.
The statement that the content validity index meets an acceptable threshold is still too general. The authors should include the results of their validity tests in the manuscript.
The manuscript states that the homogeneity of regression slopes was examined, but the results of this examination are not presented. The authors should report the results of their assumption tests.
The manuscript places heavy emphasis on p-values and effect sizes. Confidence intervals would help readers assess the precision of the reported intervention effects.
The discussion states that recognition, encouragement, professional development, and participation can explain the increase in satisfaction. However, these mediating variables were not measured. The author should be more careful when discussing the research findings. Please double-check the entire discussion chapter.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
No

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Business Administration, Human Resources Management, Law, and Governance

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 01 Sep 2026

Alrashidi Nasser Ayidh M

Reviewer: The Introduction states that most previous studies were observational or correlational in nature and that evidence from intervention-based studies in Saudi Arabian primary health care (PHC) remains limited. However, this gap is still described in general terms. The authors need to explain more explicitly what remains unknown from previous research and how this study specifically fills that gap.
Response: Thank you for this important comment. We have revised the Introduction to clarify the specific evidence gap. The revised manuscript now distinguishes between evidence describing associations between transformational leadership and nurses' outcomes and the limited evidence from structured leadership development interventions. We have explicitly stated that it remains unclear whether a structured transformational leadership programme delivered to nurse managers can improve staff nurses' job satisfaction and perceptions of the work environment in primary healthcare settings in Saudi Arabia. We have also clarified how the present quasi-experimental study addresses this gap by evaluating these outcomes following a structured intervention in primary healthcare centres in Medina, Saudi Arabia.
Reviewer: There is no chapter on literature review and hypothesis development. The authors need to add one.
Response: Thank you for this suggestion. We have added a new section entitled "Literature Review and Hypothesis Development" to provide a more explicit synthesis of the relevant literature and the theoretical rationale for the study. The new section discusses the relationship between transformational leadership, nurses' job satisfaction, and the work environment and provides the basis for the study hypotheses.
Reviewer: The manuscript explains that extrinsic satisfaction consists of 6 items on a 1–5 scale, so theoretically the maximum score is 30. However, the study results report a post-intervention average extrinsic satisfaction score of 38.06. The authors need to explain which version of the MSQ was used, the item breakdown, the score range, and the calculation method.
Response: Thank you for identifying this important issue. We have clarified the MSQ description in the Methods section. The revised manuscript specifies that the study used a 20-item questionnaire based on the short-form Minnesota Satisfaction Questionnaire (MSQ), comprising 12 items for intrinsic job satisfaction and 8 items for extrinsic job satisfaction. Each item was scored on a five-point scale from 1 to 5. Intrinsic satisfaction therefore has a possible score range of 12–60, extrinsic satisfaction 8–40, and overall job satisfaction 20–100. Scores were calculated by summing the corresponding item scores.

This clarification explains the reported post-intervention extrinsic satisfaction score of 38.06.

Reviewer: The number of nurse managers who participated in the program, their characteristics, the number of nurses under each manager, and the distribution of participants across each PHC should be reported.

Response: Thank you for this comment. We have expanded the Participants and Sample Size section to report that the transformational leadership programme was delivered to 52 nurse managers in the intervention PHCs. We have also reported the distribution of the 104 participating nurses across the seven PHCs: Al-Hijrah (n = 16), Wairah (n = 11), Al-Safiyyah (n = 13), Health Surveillance Center (n = 12), Al-Daithah (n = 13), Bab Jibreel (n = 14), and Al-Salsalah (n = 15).

The available study dataset did not include individual demographic and professional characteristics of the nurse managers, and individual nurse–manager linkages were not recorded. We have therefore stated transparently in the revised manuscript that manager-level characteristics and the number of nurses supervised by each individual manager could not be determined retrospectively.

Reviewer: The manuscript should list all items used, the response scale, the scoring method, and the score range.

Response: Thank you. We have expanded the description of both outcome instruments in the Methods section. The revised manuscript now specifies the number of items, domains, response scales, scoring procedures, and possible score ranges for both job satisfaction and work environment measures. The full set of questionnaire items used in the study is also provided as Extended Data.

Reviewer: The statement that the content validity index meets an acceptable threshold is still too general. The authors should include the results of their validity tests in the manuscript.

Response: Thank you for this valuable comment. We have revised the instrument validation section to report the numerical results of the content validity assessment. Specifically, the item-level content validity index (I-CVI) ranged from 0.83 to 0.94 across the questionnaire items, indicating acceptable content validity. This information has now been explicitly reported in the Methods section.

Reviewer: The manuscript states that the homogeneity of regression slopes was examined, but the results of this examination are not presented. The authors should report the results of their assumption tests.

Response: Thank you for pointing this out. We have clarified in the Statistical Analysis section that the assumption of homogeneity of regression slopes was assessed by testing the interaction between study group and the corresponding baseline outcome score before conducting ANCOVA.

The Results section now reports the assumption-test results. The group-by-baseline interaction was not statistically significant for overall job satisfaction ($F = 0.948$, $p = 0.333$), intrinsic job satisfaction ($F = 2.931$, $p = 0.090$), extrinsic job satisfaction ($F = 0.200$, $p = 0.656$), or work environment ($F = 0.569$, $p = 0.452$), supporting the assumption for all four outcomes.

Reviewer: The manuscript places heavy emphasis on p-values and effect sizes. Confidence intervals would help readers assess the precision of the reported intervention effects.

Response: We agree with the reviewer. To improve the reporting of the intervention effects, we have added 95% confidence intervals for the adjusted mean differences to the ANCOVA

results table. The Results section has also been revised to report the adjusted mean differences together with their 95% confidence intervals, p-values, and partial η^2 values.
Reviewer: The discussion states that recognition, encouragement, professional development, and participation can explain the increase in satisfaction. However, these mediating variables were not measured. The author should be more careful when discussing the research findings. Please double-check the entire discussion chapter.
Response: Thank you for this important observation. We have carefully revised the Discussion to ensure that mechanisms that were not directly measured are not presented as demonstrated mediators or causal pathways. The revised Discussion now distinguishes between the theoretical mechanisms described in the transformational leadership literature and the outcomes actually measured in this study. We have explicitly acknowledged that specific processes such as communication, recognition, participation, professional development, and other potential mechanisms were not directly assessed.
We have also clarified that the observed intervention effects represent adjusted differences between groups and do not establish specific causal pathways. In addition, a limitation has been added to acknowledge that potential mechanisms underlying the observed effects were not measured. The correlation findings are likewise explicitly described as associations rather than evidence of mediation or causality.

We sincerely thank the reviewer for the constructive and detailed comments. We believe that these revisions have substantially improved the methodological transparency, statistical reporting, interpretation, and overall clarity of the manuscript. All changes have been made in the revised manuscript with Track Changes enabled for ease of review.

Competing Interests: The authors declare that they have no competing interests.

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