

Exploring the Influence of Leadership Identity on Radiologists' Leadership in German University Hospitals: A Nationwide Analysis

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Background: Little is known about how physicians perceive their leadership identity and how this shapes their leadership behaviors. This study examines the relationship between leadership identification, leadership behavior, and leadership-related outcomes.

Methods: A cross-sectional survey was conducted among consultant radiologists in German university hospitals from January to November 2023. Leadership identification, leadership behavior (task orientation, relationship orientation, change orientation, and external orientation), workload, and outcome measures (staff engagement, organizational commitment, and perceived team performance) were assessed with validated self-report instruments. Pearson correlation coefficients (r) were calculated to examine relationships among the variables. Mediation analysis examined whether leadership behavior mediates the relationship between leadership identification and outcome measures.

Results: Consultant radiologists identified primarily as physicians (median = 60%, IQR: 40–80%), followed by leaders (median = 45%, IQR: 30–60%), with a negative correlation between physician and leadership identity ($r = -0.34$, $p < 0.01$). Participants reported moderate to high levels of exhaustion, with feeling physically overwhelmed receiving a median score of 4 (IQR: 3–4) on a 0–4 scale. Notably, only 25.8% of participants reported having sufficient time for leadership tasks, despite holding leadership responsibilities for a median of 75.5 months (IQR: 31.5–261). Conversely, leadership identity negatively correlated with workload ($r = -0.30$, $p < 0.05$). Leadership identification significantly predicted leadership behavior ($\beta = 0.27$, $p < 0.001$), which, in turn, was positively associated with staff engagement ($\beta = 0.30$, $p < 0.009$), confirming an indirect effect (CI: 0.0014–0.0162). However, leadership identification did not directly predict staff engagement ($\beta = 0.001$, $p = 0.94$).

Conclusion: Stronger leadership identification is associated with lower perceived workload and greater engagement in leadership behaviors, which may serve as a coping mechanism for managing leadership-related demands. However, its impact on staff engagement operates through the leadership behaviors rather than through identification alone.

Plain Language Summary: Doctors in university hospitals are often asked to take on leadership roles alongside their medical work. However, many doctors see themselves mainly as physicians and less as leaders. This can create difficulties in balancing clinical responsibilities with leadership duties.

We carried out a nationwide survey of consultant radiologists working in German university hospitals to understand how they see themselves in relation to leadership, how this affects their leadership behavior, and what impact it has on their work and their teams.

Over 100 radiologists completed our survey. Most participants said that they strongly identified as physicians, while their identity as leaders was weaker. Only about one in four reported having enough time for leadership tasks, and many described high workloads and feelings of being overwhelmed. Interestingly, radiologists who identified more strongly as leaders tended to feel less burdened by

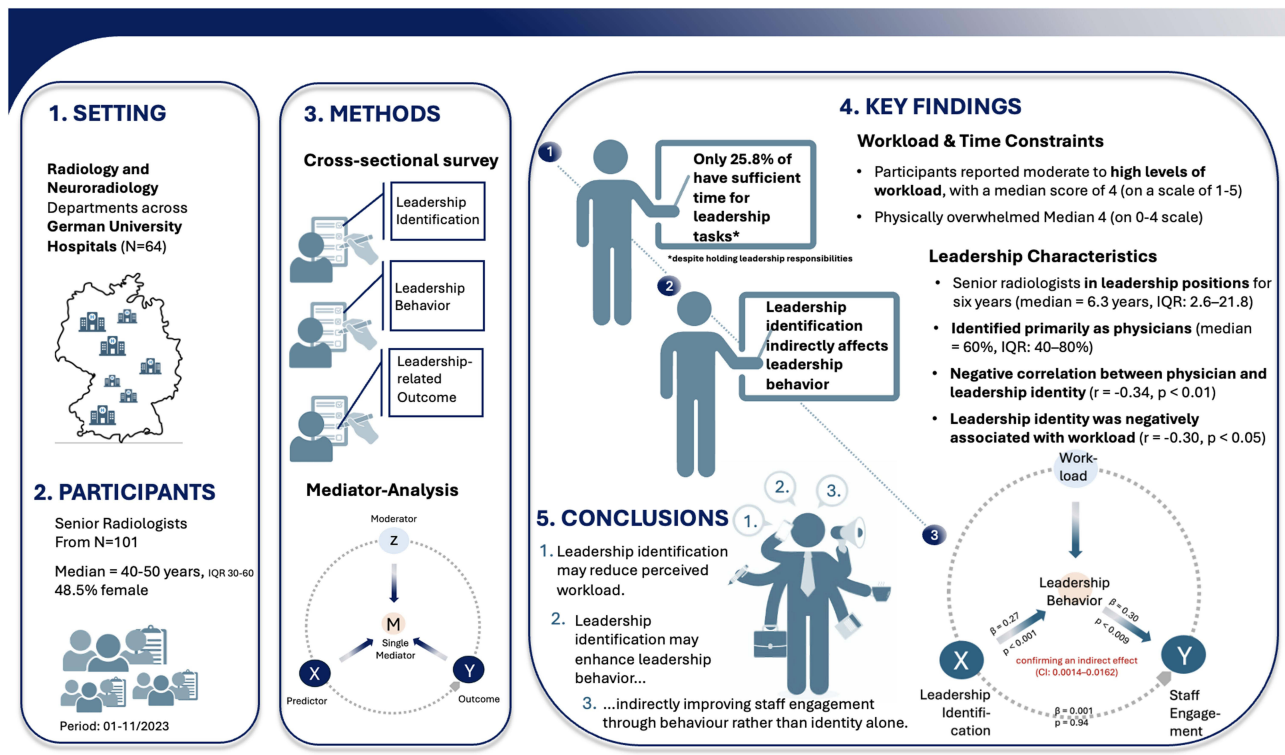


workload. Leadership identity was also linked to more active leadership behaviors, such as supporting team members and promoting change. These behaviors, in turn, were associated with higher levels of staff engagement.

Our findings suggest that simply calling doctors “leaders” is not enough. It is the combination of identifying as a leader and actively showing leadership behaviors that makes a difference for staff motivation and team performance. Encouraging early development of a leadership identity in medical training, alongside providing time and support for leadership activities, may help doctors to thrive in these roles and improve staff engagement.

Keywords: leadership, radiology department hospital, health services administration, professional role, self concept, surveys and questionnaires, cross-sectional studies, Germany, academic hospitals, leadership identity

Graphical Abstract



Introduction

In modern healthcare systems, physicians are increasingly required to assume leadership responsibilities alongside their clinical duties.^{1,2} Internationally, the expectation of all doctors to engage in leadership and management is enshrined in guidance from regulators and other bodies, eg the United Kingdom’s General Medical Council and in Canada via the CanMEDS framework.³ However, many physicians struggle to integrate leadership into their professional identity, often encountering tensions between their clinical expertise and managerial obligations.⁴ Unlike traditional leadership trajectories, where individuals typically progress through structured leadership development pathways, physicians frequently ascend to leadership roles based on medical expertise rather than formal leadership training.² Consequently, leadership competencies and systematic preparation are often secondary considerations, creating challenges in leadership adaptation and engagement. While much of the existing research emphasizes structural determinants of physician leadership, such as training programs, competency frameworks, and organizational support,⁵ an equally critical yet underexplored factor is

leadership identification. Leadership identification describes the extent to which physicians perceive themselves as leaders and has been linked to leadership effectiveness, proactive engagement, and team performance in management research.^{6,7} Moreover, individuals with a strong leadership identity are more likely to take ownership of leadership responsibilities and exhibit behaviors conducive to effective leadership, whereas weaker identification can lead to role conflict, reluctance to lead, and heightened stress.^{8–10}

Leadership, historically conceptualized as a formal and hierarchical construct by Bedeian and Hunt,¹¹ is increasingly recognized as a socially constructed and relational process.¹² This conceptual shift emphasizes leadership not as an assigned static role, but as an evolving identity constructed through continual social interaction.^{13,14} Grounded in two theoretical frameworks, the social identity theory and the self-categorization theory (Tajfel & Turner, 1970s–1990s), this view proposes that leadership emergence and effectiveness are fundamentally shaped by individuals' identification with a collective group.^{15–17} Developed between the late 1970s and early 1990s, these theories collectively form the social identity approach, emphasizing the role of shared group membership in leadership emergence and effectiveness.¹⁸ Within this framework, leadership is defined by personal attributes but by the leader's ability to represent and promote a collective sense of "us".¹⁹ By cultivating this shared identity, effective leadership aligns individual motivations with group objectives, thereby enhancing team performance and organizational commitment.²⁰

Despite the recognized importance of leadership identity in organizational psychology, its implications within medical settings remain underexplored.²¹ The hierarchical structure and clinically driven nature of medical professions create unique leadership challenges, complicating the process of leadership identification among physicians.²² Existing studies on physician leadership have largely focused on external determinants, such as institutional support and leadership development programs, while the internal psychological mechanisms that shape leadership engagement remain insufficiently studied.^{2–4} While qualitative research has illuminated the tensions between clinical and managerial roles, quantitative assessments of leadership identification and its behavioral consequences remain scarce.

The field of radiology is particularly relevant in this context for investigating how leadership identity develops and influences leadership behavior in healthcare, as radiologists operate under considerable mental, cognitive, and organizational pressure that is likely to amplify role conflicts between clinical and leadership identities. In a large academic center, over one-third of radiology faculty reported burnout, with perceived leadership quality and values alignment among the strongest predictors.²³ Globally, burnout prevalence among radiology professionals has been reported to range between 33% and 88%, with a significant association to increased workload.²⁴ Even radiologists in leadership or private practice settings report high burnout rates and low professional fulfillment, with heavy after-hours work and on-call duties identified as key risk factors—representing structural and organizational stressors that may not only impair physicians' well-being but also complicate their engagement in leadership roles.²⁴ Consultants in particular hold pivotal roles within radiology departments. Unlike department heads who often shift to mainly managerial duties, consultants work at the intersection of clinical care and leadership.²⁵ They lead large teams, oversee daily operations, and balance teaching with administrative tasks, thereby placing them under significant pressure.^{25,26} This study aims to bridge this gap by systematically examining how leadership identification influences leadership behaviors and related outcomes among consultant radiologists in German university hospitals. Using a self-assessment methodology, we assess the extent to which physicians identify with their leadership role and whether this identification translates into active leadership engagement. Understanding these dynamics is essential for informing targeted interventions that strengthen leadership identification, reduce role strain, and enhance leadership effectiveness in healthcare settings.

Methods

Ethical and Data Protection Considerations

A data protection concept was approved by the local data protection department, ensuring confidentiality and anonymity. Ethical approval for this study was obtained from the Charité – Universitätsmedizin Berlin Ethics Committee (reference EA1/174/20), followed by final authorization from the local staff council. The study was conducted in accordance with the ethical standards of the institutional and national research committee, and with the 1964 Helsinki declaration and its later amendments. Prior to participation, all respondents were provided with detailed written information about the

purpose of the study, data confidentiality, voluntary participation, and the anonymous nature of data collection. Informed consent was obtained electronically at the beginning of the online questionnaire by requiring participants to actively confirm their consent before proceeding. Participation was only possible after consent was given. No identifying personal data were collected. The original questionnaire was administered in German. Both the original German version and an English translation (including the consent text and all items used in the study) are provided in the [Supplementary Material](#). The English version was generated using ChatGPT (GPT-4o, OpenAI).

Study Design and Participants

Consultant radiologists at German university hospitals were invited to participate in a nationwide survey, other staff members were not surveyed. To identify eligible institutions, we conducted an internet-based search of all medical faculties in Germany and reviewed their associated university hospitals for dedicated departments of radiology (N=37) and neuroradiology (N=27). A list of departments was compiled, and contact information for department heads or senior staff was extracted and organized in a spreadsheet. Departments were contacted simultaneously at study initiation, which spanned three months, with a reminder sent ten days before the deadline. Data collection occurred in two phases. The first distribution of an online questionnaire took place in January 2023. Following an interim analysis, a second distribution in July 2023 targeted non-respondents from Phase 1.

Overall, N=101 consultant radiologists participated in the study. The study included consultant radiologists with a median age of 40–50 years (IQR: 30–60), of whom 31.68% were female (n = 32).

Questionnaire Design

To ensure content validity, the questionnaire was independently piloted with three consultant radiologists (MS, EC, SMN) with leadership responsibilities, before the final version was distributed to study participants.

Questionnaire Distribution

The online questionnaire was generated and made available to users via www.soscisurvey.de (SoSci Survey (Version 3.5.01) [Computer software]).²⁷ For the purpose of this study, a local server for data storage was hosted on-premise, ensuring that all collected data remained on premise within the local IT infrastructure.

Data Collection Instruments

The questionnaire was divided into three parts, with additional details provided in the [Supplementary Material](#):

Leadership Identity

PART I of the questionnaire captured key aspects of individual leadership identity based on self-perception, including leadership identity, professional identity, and organizational identity.^{21,28} A continuous scale from 0% (“not at all”) to 100% (“to a very high degree”) was used as a metric.

- **Leadership Identity:** Participants were asked to rate their agreement with the statement “I am a leader”.
- **Professional Identity:** Participants allocated importance among three aspects of their professional identity: physician, researcher, and leader.
- **Organizational Identity:** Participants evaluated the relevance of three hierarchically nested organizational levels to their professional identity: (1) their immediate clinical unit (eg, ward, operating room, or diagnostic unit), (2) their department (eg, radiology), and (3) the overarching institution (university hospital).

Leadership Behavior

PART II assessed the extent to which participants exhibited leadership behaviors, utilizing a structured and validated approach. Items in this section were adapted from the German Managerial Practice Survey (GMPS), a well-established German-language instrument designed to measure key leadership dimensions.²⁹ The proposed taxonomy builds on the extensive factor analysis research by Yukl et al with the four meta-categories of leadership behavior identified in *Hierarchical Taxonomy of Leadership Behaviors* ([Supplementary Figure 1](#)).³⁰ Each of these categories was assessed

using a set of items: (1) task orientation (N = 4 items), (2) relationship orientation (N = 4 items), (3) change orientation (N = 4 items), and (4) external orientation (N = 5 items), resulting in a total of 17 items (see [Supplementary Material](#) for details). A representative item measuring task orientation is: “I ensure that team members have a clear understanding of their roles and related procedures. Participants rated each item using a five-point Likert scale anchored at 0% (not at all), 25% (very little), 50% (somewhat), 75% (to a great extent), and 100% (to a very great extent)”.

Outcome Measures

PART III covered the outcome measures categorized into three subgroups. The subgroups included: (1) individual engagement (N= 6 items) and (2) organizational commitment (N=4 items), which were assessed using items adapted from the Employee Experience Questionnaire (EXQ) by Fischer et al which comprises four aspects: job satisfaction, organizational commitment, individual engagement, and collective engagement.³¹ (3) Additional perceived team performance (N= 3 subitems) was evaluated based on the work by Schaubroeck et al³² Each item was measured using a 7-point Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree). A total of 13 items were surveyed (see [Supplementary Material](#)).

Demographic Data

Part IV featured extended attributes of the participants including demographic data to provide context to the leadership aspects, as outlined in the [Supplementary Material](#).

Data Analysis and Statistics

Data were cleaned, and incomplete responses were removed as shown in [Figure 1](#). Descriptive statistics summarized participant demographics and survey responses. Normality of continuous variables was assessed using the Shapiro–Wilk

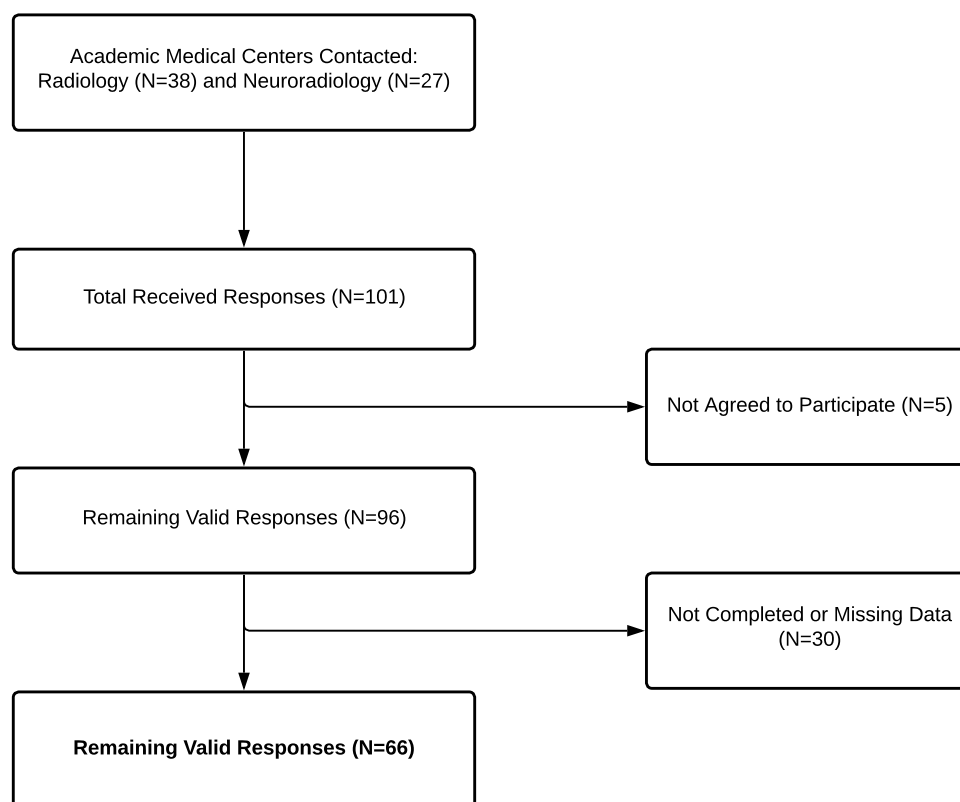


Figure 1 Flowchart of Survey Distribution and Response Collection Among Radiology and Neuroradiology Departments in German University Medical Centers. **Note:** Bold text indicates the final sample size included in the analysis (N = 66).

test; normally distributed data were reported as mean \pm standard deviation (SD), while non-normal data were presented as median and interquartile range (IQR). Categorical variables were expressed as frequencies and percentages.

Reliability Analysis and Inter-Item Correlations

Internal consistency (ie, reliability) was evaluated by calculating Cronbach's alpha, between the conceptually aligned items, [Supplementary Material](#).³³ Cronbach's alpha measures the reliability of parallel items designed to assess a unidimensional construct, with values ≥ 0.7 considered acceptable and ≥ 0.6 as the minimum threshold.³⁴ Average inter-item correlation was assessed using a correlation matrix for conceptually aligned mean items, [Supplementary Material](#). This analysis examines the degree to which items within a scale are related, providing insight into item redundancy and content overlap.³⁵ Ideally, inter-item correlations should range between 0.20 and 0.40, indicating sufficient homogeneity while preserving unique variance among items.³⁵

Computation of Aggregate Mean Variables

New mean variables were computed for items related to leadership behavior, outcome variables, and workload by aggregating multiple subitems into composite variables, as detailed in the [Supplementary Material](#).

Correlation Analysis of Leadership Identity and Related Outcome Variables

Pearson correlation coefficients were calculated to assess relationships among leadership identity, outcome variables, and workload, using mean variables, and other leadership-associated factors. Correlation strength was classified as strong (± 0.50 to ± 1.0), moderate (± 0.30 to ± 0.49), or weak ($\leq \pm 0.29$), with 0 indicating no relationship.³⁶

Mediation Analysis

Mediation and moderation analyses were conducted using the PROCESS macro for SPSS (version 2.13), specifically employing Model 5. This model allows simultaneous testing of a mediation pathway and a moderation effect ([Supplementary Figure 2](#)).^{37,38} To assess the presence of an indirect effect (Path a*b), a bias-corrected bootstrapped 95% confidence interval (CI) was computed. Support for the mediation model was established if the CI did not include zero; conversely, if zero was contained within the CI, the indirect effect was not considered.³⁸ In addition, a moderation analysis was performed to examine whether "workload" moderates the relationship between "leadership behavior" and "staff engagement". The interaction term between leadership behavior and workload was included in the model and tested for statistical significance.

All results were reported in an aggregated and anonymized format to ensure participant confidentiality. Data were analyzed using SPSS V.20.0. (IBM Corp., 2011). For data visualization Python (Version Python 3.12.5, Python Software Foundation) was used. Specifically, the matplotlib and numpy libraries were employed to create bar charts representing leadership behaviors and staff engagement. The flowchart was created using Lucidchart (Lucid Software Inc., 2024).

Results

Details on response times, reliability analysis, and inter-item correlations are provided in the [Supplementary Material](#).

Participant Characteristics

Participants reported leading a median of 10 (IQR: 4–24.25) medical staff members and had held leadership responsibilities for a median of 75.5 months (IQR: 31.5–261). Agreement with the Leadership Identity Statement was high, with a median score of 80% (IQR: 70–100%) on a 0–100% scale. Regarding professional identity, the importance of being a medical doctor was rated highest (median = 60%, IQR: 40–80%), followed by the importance of being a leader (median = 45%, IQR: 30–60%) and researcher (median = 20%, IQR: 10–40%) on a 0–100% scale. Similarly, for organizational identity, the medical center was rated most important (median = 50%, IQR: 30–77%), followed by the department (median = 45%, IQR: 30–80%) and subunit (median = 5.5%, IQR: 4–10%) on a 0–100% scale. A detailed summary of the results is presented in [Table 1](#).

Table 1 Descriptive Characteristics

Characteristics	
Age, median (IQR)	40–50 (30–60)
Female, n (%)	32 (31.68)
Number of Medical Staff Led, median (IQR)	10 (4–24.25)
Duration of Leadership Responsibility [months], median (IQR)	75.50 (31.5–261)
Agreement with Leadership Identity Statement [0–100%], median (IQR)	80 (70–100)
Importance of Professional Identity [0–100%], median (IQR)	
• Medical doctor	60 (40–80)
• Researcher	20 (10–40)
• Leader	45 (30–60)
Importance of Organizational Units to Professional Identity [0–100%], median (IQR)	
• Subunit	5.5 (4–10)
• Department	45 (30–80)
• Medical Center	50 (30–77)
Workload [0–4]*, median (IQR)	
• Feel physically exhausted after work.	4 (3–4)
• Feel responsible for too much.	3 (2–3.75)
• Feel overwhelmed by the workload.	4 (3–4)
Percentage of Working Hours among Professional Responsibilities [0–100%], median (IQR)	
• Clinical Duties	70 (60–80)
• Research and Teaching	15 (10–20)
• Academic Administration	10 (10–27.5)
“Do you have any time left for your leadership tasks?” [Yes], n (%)	17 (25.8)
Leadership Development Measures taken [0–100%], n (%)	
• Training/Workshop	30 (45.5)
• Coaching	16 (24.2)
• Mentoring	15 (22.7)
• Peer discussion	28 (22.7)
Duration in Leadership Development Measures [months], median (IQR)	6–12 (0–6;12–24)
Digital Media Utilization	
Leadership Tasks Conducted Digitally [0–100%], median (IQR)	50 (30–60)

(Continued)

Table 1 (Continued).

Characteristics	
Utilization of Digital Media Sources [1–4]**, median (IQR)	
• Email	4 (4;4)
• Video Conferencing Platforms	3 (2;3)
• Instant Messaging Services	2 (1;3)
• Blogging Services	1 (1,1)

Notes: *Responses were coded as follows: never [0], rarely [1], sometimes [2], often [3], always [4]. **Responses were coded as follows: 1 = not at all (0%), 2 = very little (25%), 3 = to a large extent (75%), 4 = to a very large extent (100%).

Workload and Professional Responsibilities

Participants reported moderate to high levels of workload, with a median score of 4 (IQR: 3–4 on a scale of 1–5) for feeling physically exhausted and overwhelmed by the workload, while the perceived “role overload” was rated slightly lower (median = 3, IQR: 2–3.75). The majority of working hours were allocated to clinical duties (median = 70%, IQR: 60–80), whereas research and teaching (median = 15%, IQR: 10–20) and academic administration (median = 10%, IQR: 10–27.5) were given less time. Only 25.8% (n = 17) of participants reported having sufficient time for their leadership tasks. Engagement in leadership development measures was reported at 30% (training/workshops), 24.2% (coaching), and 22.7% (peer discussions and mentoring).

Digital Media Utilization and Leadership Tasks

Leadership tasks were conducted digitally at a median of 50% (IQR: 30–60) of the time on a 0–100% scale. Email was the most frequently used digital medium, with a median utilization of 100% (IQR: 100–100), followed by video conferencing platforms at 75% (IQR: 50–75). Instant messaging services were used to a lesser extent, with a median utilization of 25% (IQR: 0–50), while blogging services were the least used, with a median utilization of 0% (IQR: 0–0).

Leadership Behavior Characteristics

Table 2 and Figure 2 provide a detailed overview of the leadership behavior characteristics assessed in the study. Leadership behaviors were categorized into task orientation, relationship orientation, change orientation, and external orientation, with responses rated on a 0–100% scale.

Table 2 Characteristics of Leadership Behavior

Leadership Behavior (0–100%)		Median [%] (IQR)
Task Orientation	• Shared Understanding of Team Goals	75 (75–75)
	• Team Responsibilities and Processes Understood	75 (75–100)
	• Defined Criteria for Evaluating Progress	50 (75–100)
	• Timely Intervention in Problems	75 (75–75)
Relationship Orientation	• Fostering Team Cohesion and Mutual Support	75 (75–100)
	• Considering Individual Needs in the Team	75 (75–100)
	• Expressing Honest Appreciation for Overcoming Challenges	100 (75–100)
	• Supporting Team Development (Skills, Career)	75 (50–100)

(Continued)

Table 2 (Continued).

Leadership Behavior (0–100%)		Median [%] (IQR)
Change Orientation	• Encouraging and Promoting Change	75 (50–95)
	• Communicating a Clear Team Vision	75 (50–100)
	• Challenging and Critically Evaluating Solutions	75 (50–100)
	• Consistently Learning from Mistakes	75 (50–100)
External Orientation	• Attracting Experts Outside the Team	75 (25–75)
	• Identifying Opportunities and Risks Outside the Team	50 (50–75)
	• Representing the Team Externally	75 (75–100)
	• Department Supports My Leadership	75 (50–75)
	• University Clinic Supports My Leadership	50 (25–75)

Notes: A total of 17 behavior-related items focusing on task orientation, relationship orientation, change orientation, and external orientation were assessed. Each item was rated on a scale with the following anchors: (0%) not at all, (25%) very little, (50%) somewhat, (75%) to a great extent, and (100%) to a very great extent.

Task Orientation

Participants' self-ratings indicated consistently high levels of task-oriented leadership behaviors, with a median score of 75% across multiple items. Ensuring a shared understanding of team goals, clarifying team responsibilities, and timely intervention in problems were particularly prominent (median = 75%, IQR: 75–100), while defining criteria for evaluating progress were less prominent (median = 50%, IQR: 75–100).

Relationship Orientation

Participants also rated their relationship-oriented leadership behaviors as high, with expressing honest appreciation for overcoming challenges receiving the highest score (median = 100%, IQR: 75–100). Other behaviors, such as fostering team cohesion, considering individual needs, and supporting team development, were also frequently reported (median = 75%, IQR: 75–100).

Change Orientation

Leadership behaviors related to change orientation, such as encouraging change, communicating a clear team vision, and critically evaluating solutions, were consistently reported as high with a median of 75% (IQR: 50–100).

External Orientation

External orientation behaviors showed the widest variability in responses. While representing the team externally was rated as high (median = 75%, IQR: 75–100), other aspects such as attracting external experts (median = 75%, IQR: 25–75) and identifying external opportunities and risks (median = 50%, IQR: 50–75) were rated lower. Notably, perceived institutional support for leadership was moderate, with department support at 75% (IQR: 50–75) and university clinic support at 50% (IQR: 25–75).

Leadership-Related Outcomes

Table 3 and Figure 3 present the findings on staff engagement as perceived by radiology leaders, categorized into team performance, individual engagement, and organizational commitment. Responses were measured using a 7-point Likert scale (0 = strongly disagree to 6 = strongly agree).

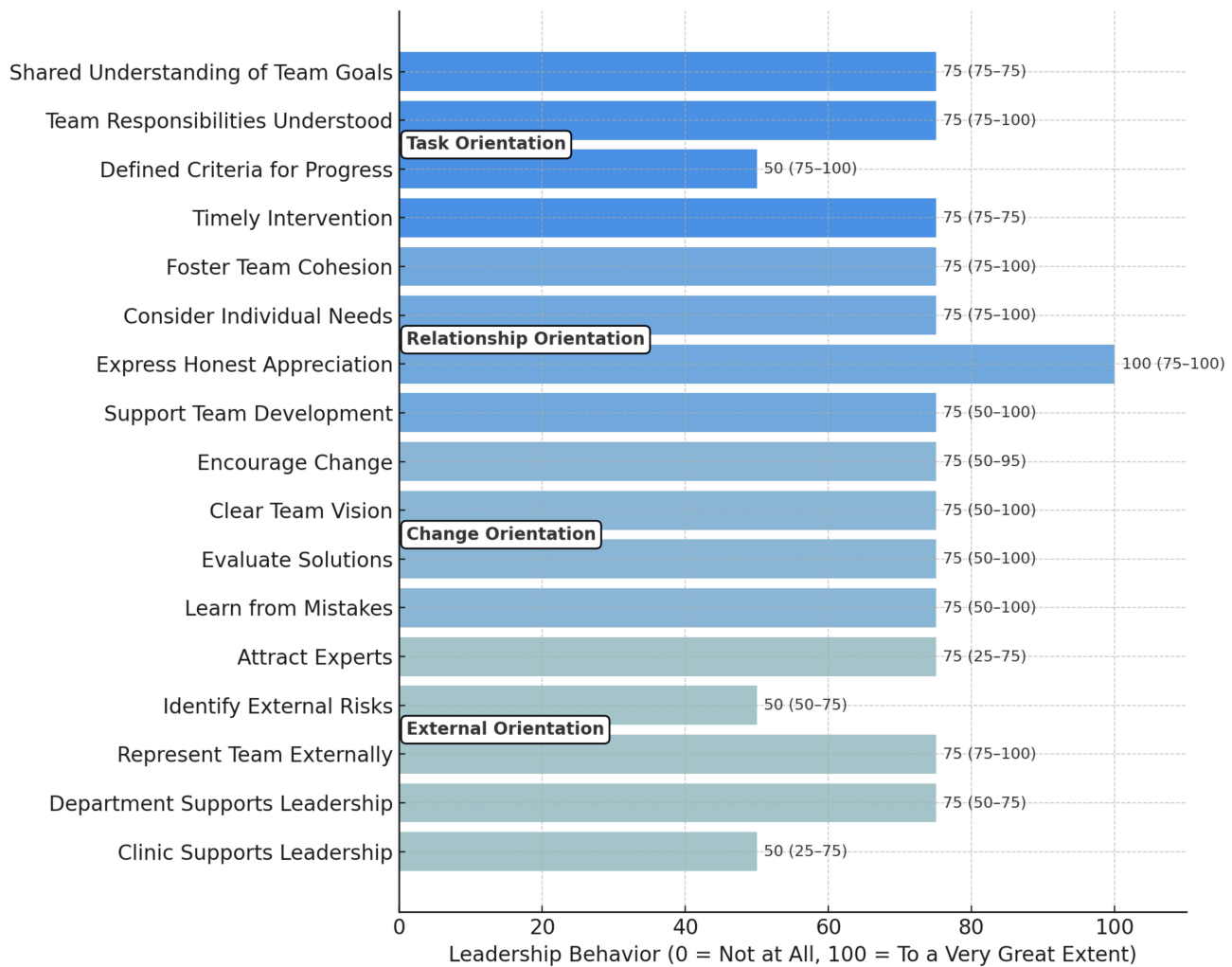


Figure 2 Leadership Behavior Ratings Among Consultant Radiologists.

Notes: This figure presents the median ratings of various leadership behaviors among consultant radiologists, categorized into four leadership orientations. Task orientation (dark blue) includes behaviors related to operational efficiency, such as defining team goals and ensuring timely intervention in problems. Relationship orientation (medium blue) focuses on interpersonal leadership skills, such as fostering team cohesion, supporting individual needs, and expressing appreciation. Change orientation (light blue) encompasses behaviors that drive innovation, including promoting change, evaluating solutions, and learning from mistakes. External orientation (mint blue) reflects leadership behaviors related to interactions beyond the immediate team, such as representing the team externally and securing institutional support. Each bar represents a specific leadership behavior, with the corresponding median percentage values displayed on the x-axis. The meta-categories are labeled above their respective groupings for clarity.

Team Performance

Leaders assessed the performance of their teams as high, with staff competence receiving the highest rating (median = 5, IQR: 4–5). Other performance indicators, such as effectiveness and achievement of good results, had median scores of, 4 (IQR: 3–5 and 4–5, respectively), indicating strong but slightly variable perceptions of staff performance.

Table 3 Characteristics of Outcome Items Related to Aspects of Leadership Perception

Perception of Staff Engagement, Median (IQR)		Median (IQR)
Team Performance	My staff are highly competent.	5 (4–5)
	My staff work very effectively.	4 (3–5)
	My staff achieve good results.	4 (4–5)

(Continued)

Table 3 (Continued).

Perception of Staff Engagement, Median (IQR)		Median (IQR)
Individual Engagement	My staff invest a lot of energy into their work.	5 (4–6)
	My staff do their best to deliver good performance.	5 (4–6)
	My staff work with full enthusiasm.	4 (3–5)
	My staff carry out their work with great joy.	4 (3–4)
	My staff focus heavily on their work.	4 (3–5)
	My staff are captivated by their work.	4 (3–5)
Organizational Commitment	My staff consider the clinic to be the best employer.	4 (3–5)
	The future of the clinic is very important to my staff.	4 (3–6)
	I can imagine my staff recommending the clinic to their friends.	4 (3–5)
	My staff are proud to say they belong to this clinic.	5 (3–5)

Notes: A total of 13 items related to the perception of staff engagement, as rated by the leader, were assessed focusing on team performance, individual engagement, and organizational commitment. Each item was measured using a 7-point Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree).

Individual Engagement

Individual engagement of staff was also rated to be high, with staff energy investment and effort to deliver good performance receiving median scores of 5 (IQR: 4–6). Other indicators, such as enthusiasm, joy in work, and focus, had median scores of 4, showing that while staff are perceived as engaged, there is some variation in intrinsic motivation levels across individuals.

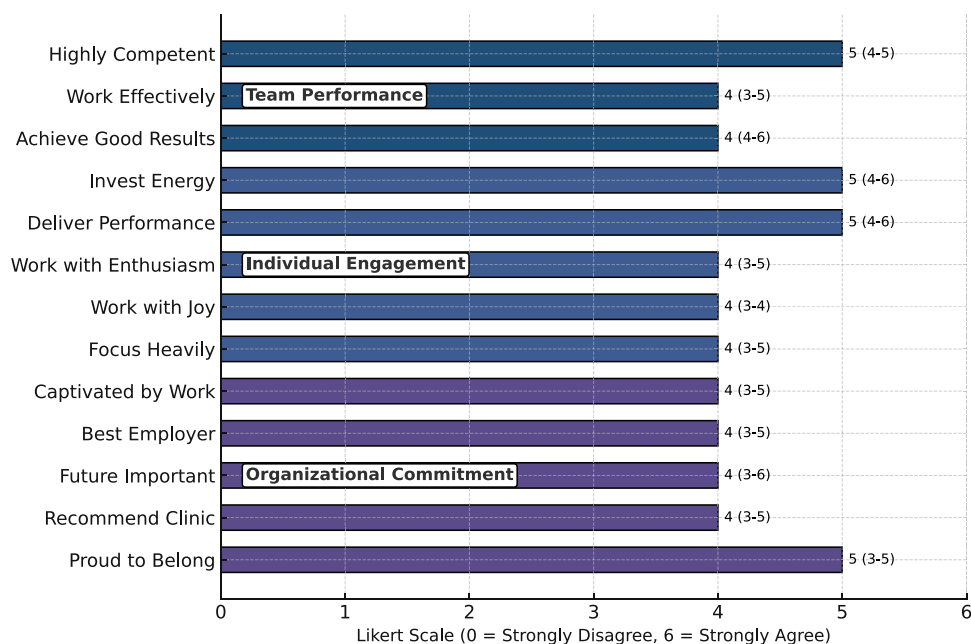


Figure 3 Leadership Behaviors and Staff Engagement in Radiology: Examining Leadership Identity and Its Impact on Team Dynamics.

Notes: Leadership behaviors were assessed across four meta-categories: Task Orientation, Relationship Orientation, Change Orientation, and External Orientation based on a Likert scale (0 = Strongly Disagree, 7 = Strongly Agree). The x-axis represents the Likert scale scores, while the y-axis lists the four meta-categories and their respective dimensions. Team Performance (dark blue): Assesses perceptions of staff competence, effectiveness, and ability to achieve good results. Individual Engagement (medium blue): Reflects the energy, enthusiasm, and dedication staff members bring to their work. Organizational Commitment (purple): Represents staff members' connection to their workplace, including their likelihood of recommending the clinic and their pride in belonging.

Organizational Commitment

Commitment to the clinic was moderately high, with most indicators receiving a median score of 4. Staff pride in being associated with the clinic had a higher rating (median = 5, IQR: 3–5), while seeing the clinic as the best employer and valuing its future were rated slightly lower (median = 4, IQR: 3–5 and 3–6, respectively).

Correlation Analysis

As shown in [Table 4](#), a significant negative correlation was observed between physician identity and leadership identity ($r = -0.34$, $p < 0.01$), indicating that individuals who identified more strongly as physicians tended to identify less strongly as leaders. Similarly, leadership identity was negatively correlated with perceived workload ($r = -0.30$, $p < 0.05$), suggesting that higher workload levels were associated with weaker identification as a leader. Additionally, gender was negatively correlated with workload ($r = -0.36$, $p < 0.01$), indicating that female leaders reported higher workloads than their male counterparts. Leadership behaviors, particularly relationship and change orientation, were strongly associated with perceived staff engagement, one of the outcome measure: Relationship-oriented leadership was positively correlated with perceived individual engagement ($r = 0.36$, $p < 0.01$) and change-oriented leadership was significantly correlated with perceived individual engagement ($r = 0.36$, $p < 0.01$). Also, more intercorrelations were observed among leadership behaviors and outcome measures ([Supplementary Material](#)).

Mediator and Moderator Analysis

Leadership identification emerged as a significant positive predictor of leadership behavior ($\beta = 0.27$, $SE = 0.08$, $p < 0.001$). Leadership behavior, in turn, had a positive and statistically significant direct effect on staff engagement ($\beta = 0.30$, $SE = 0.01$, $p < 0.009$). To test the indirect effect (Path a*b), the bootstrap confidence interval (CI) was examined. The bootstrap CI (lower limit = 0.0014, upper limit = 0.0162) did not contain zero, supporting the hypothesized indirect effect. However, the direct effect of leadership identification on staff engagement (Path c) was not statistically significant ($\beta = 0.001$, $SE = 0.01$, $p = 0.94$).

A moderation model was tested to examine whether workload moderates the relationship between leadership behavior and staff engagement. The interaction term between leadership behavior and workload was statistically significant ($\beta = 0.01$, $SE = 0.01$, $p = 0.03$).

Discussion

This study examined the relationship between leadership identification, leadership behavior, and leadership-related outcomes among consultant radiologists in German university hospitals. The findings suggest that while radiologists in leadership positions recognize their leadership roles, their professional identity remains primarily centered on their physician identity, with 60% identifying primarily as physicians and 45% identifying as leaders. This aligns with previous research suggesting that physician leadership often evolves as an additional responsibility rather than a primary professional focus with structural training during early careers or university.³⁹

This could also explain why we found a significant negative correlation between identifying as a physician and identifying as a leader ($r = -0.34$, $p < 0.01$), suggesting that a stronger physician identity is associated with a weaker leadership identity. This finding aligns with research highlighting that physicians may struggle to fully embrace leadership roles due to professional norms emphasizing clinical expertise over managerial responsibilities.⁴⁰

Workload, Burnout, and Leadership Impact

Workload and time constraints emerged as major challenges for radiologists in leadership positions. Participants reported moderate to high levels of exhaustion, with feeling physically overwhelmed receiving a median score of 4 (IQR: 3–4) on a 0–4 scale. Notably, only 25.8% of participants ($n = 17$) reported having sufficient time for leadership tasks, despite holding leadership responsibilities for a median of 75.5 months (IQR: 31.5–261 months). These findings align with the wider literature on physician burnout, which has reached prevalence rates exceeding 50%.⁴¹ Radiologists, in particular, are increasingly affected, ranking fourth among medical specialties with a burnout prevalence of 46% to 88%.^{24,42} A systematic review of burnout in radiology reported burnout prevalence reaching 88%, with 62% experiencing high levels

Table 4 Correlation Analysis of Leadership Identity, Outcome Variables, and Leadership-Associated Factors

	Sex	Age	Leader (Yes/No)	Number of Employees Led	Duration of Leadership	ID_Physician	ID_Researcher	ID_Leader	Behavior: Task Orientation	Behavior: rs_orientation	Behavior: ch_orientation	Behavior: ex_orientation	Perception: perc_team	Perception: ind_eng	Perception: org_com	Workload
Sex	1	0.159	0.240	0.033	0.066	0.011	-0.097	-0.048	0.163	0.114	-0.085	-0.037	-0.053	0.018	0.086	
Age	0.159	1	0.215	0.002	0.256	0.270	-0.275*	-0.169	0.159	0.035	-0.042	0.028	-0.040	-0.130	0.200	-0.268
Leader (yes/no)	0.240	0.215	1	-0.003	-0.197	-0.340**	0.087	0.289*	0.317*	0.381**	0.365**	0.320*	0.046	0.179	0.328*	-0.304*
Number of employees led	0.033	0.002	-0.003	1	0.208	0.039	-0.270*	-0.222	0.152	0.195	0.009	0.112	-0.146	-0.062	0.112	-0.096
Duration of leadership	0.066	0.256	-0.197	0.208	1	0.186	-0.174	-0.003	-0.146	0.001	-0.249	-0.200	-0.198	-0.148	0.038	0.028
ID_Physician	0.011	0.270	-0.340**	0.039	0.186	1	-0.009	-0.065	-0.083	-0.051	-0.213	-0.430**	0.101	0.003	0.015	-0.098
ID_Researcher	-0.097	-0.275*	0.087	-0.270*	-0.174	-0.009	1	0.451**	0.214	0.142	0.378**	0.039	-0.061	0.268*	0.032	0.192
ID_Leader	-0.048	-0.169	0.289*	-0.222	-0.003	-0.065	0.451**	1	0.134	0.217	0.061	0.018	0.099	0.223	0.034	0.070
Behavior: task orientation	0.163	0.159	0.317*	0.152	-0.146	-0.083	0.214	0.134	1				0.031	0.242	0.162	-0.176
Behavior: rs_orientation	0.114	0.035	0.381**	0.195	0.001	-0.051	0.142	0.217	0.371**	1						
Behavior: ch_orientation	-0.085	-0.042	0.365**	0.009	-0.249	-0.213	0.378**	0.061	0.578**	0.515**	1					
Behavior: ex_orientation	-0.037	0.028	0.320*	0.112	-0.200	-0.430**	0.039	0.018	0.485**	0.468**	0.662**	1				
Perception: perc_team	-0.053	-0.040	0.046	-0.146	-0.198	0.101	-0.061	0.099	0.031	0.223	0.156	0.143	1			
Perception: ind_eng	0.018	-0.130	0.179	-0.062	-0.148	0.003	0.268*	0.223	0.242	0.359**	0.361**	0.189	0.723**	1		
Perception: org_com	0.086	0.200	0.328*	0.112	0.038	0.015	0.032	0.034	0.162	0.150	0.236	0.162	0.345*	0.543**	1	
Workload	-0.362**	-0.268	-0.304*	-0.096	0.028	-0.098	0.192	0.070	-0.176	-0.056	-0.127	-0.040	0.148	0.085	-0.134	1

Notes: Pearson correlation matrix examining associations between leadership identity, leadership behaviors, outcome variables (team performance, individual engagement, organizational commitment), and contextual factors such as sex, age, workload, and leadership experience. Leadership identification correlated with leadership behaviors and perceived staff engagement, while a significant negative correlation was found with perceived workload. Mean values are provided for the different subitems related to leadership behavior, perception, and workload. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Abbreviations: Ch, change; ex, external; ID, identification as; ind_eng, individual engagement; rs, relationship; org_com; organizational commitment; perc_team, perceived team performance.

of burnout.²³ This highlights that radiology is not immune to the burnout epidemic, with excessive workloads, inefficient workflows, and administrative burdens being key contributors. Moreover, poor leadership and organizational climate factors have been directly linked to burnout.⁴³ Research has shown that negative leadership behaviors, limited inter-professional collaboration, restricted career advancement opportunities, and lack of social support significantly exacerbate burnout.⁴¹ Importantly, a lack of engagement from leadership regarding work-life balance and organizational decision-making has been identified as a major driver of physician dissatisfaction. A negative correlation between leadership identity and workload ($r = -0.30$, $p < 0.05$) in our study suggests that those who identify more strongly as leaders tend to perceive lower workload levels, possibly due to better delegation strategies or a greater sense of control over their work environment, also known as “powerful stress-buffering effects” among leaders.⁴⁴ However, with burnout prevalence in radiology increasing globally, leadership behaviors should not only focus on operational efficiency but also proactively address burnout risk factors by promoting engagement, reducing workload and administrative burdens, and fostering a supportive work culture. Our results also highlight significant gender differences in workload perception, with female leaders perceiving significantly higher workloads than their male counterparts ($r = -0.36$, $p < 0.01$). This finding may reflect broader systemic inequalities in task distribution or work-life balance challenges that disproportionately affect female leaders. This issue is particularly important in the context of medical workforce demographics, as medicine, including radiology, is increasingly becoming a female-dominated profession.⁴⁵ In several countries, the majority of medical students and early-career physicians are women, meaning that workforce challenges affecting female physicians will have broad economic and operational implications for healthcare systems.

Leadership Behaviors and Engagement

Leadership behaviors were assessed across four domains: task orientation, relationship orientation, change orientation, and external orientation. Task-oriented behaviors were consistently rated highly, with a median score of 75% (IQR: 75–100%), reflecting a strong emphasis on operational efficiency. Relationship-oriented leadership behaviors, such as expressing honest appreciation for overcoming challenges, received the highest median rating (100%, IQR: 75–100%), reinforcing the importance of interpersonal dynamics in leadership effectiveness. Change orientation behaviors, including fostering innovation and communicating a clear team vision, were rated at a median of 75% (IQR: 50–100%), while external orientation behaviors showed greater variability, with departmental support rated higher (median = 75%, IQR: 50–75%) compared to university clinic support (median = 50%, IQR: 25–75%). These results align with prior research emphasizing the importance of adaptive leadership that integrates behaviors across all four meta-categories.^{46,47} This suggests that radiologists possess the fundamental potential to be effective leaders, as they already demonstrate competencies across task-, relationship-, change-, and external-oriented leadership behaviors. Given the growing complexity of radiology—increasing imaging demands, workforce shortages, and AI-driven transformation—the ability to flexibly integrate different leadership behaviors will become even more critical. Yukl and Mahsud’s concept of flexible leadership highlights that effective leaders do not rely on a single dominant style but instead adjust their behaviors to meet changing demands.⁴⁸ However, it is important to note that these results are based on self-reflection, meaning they represent subjective self-assessments rather than objective measures of leadership effectiveness.

Leadership as a Mechanism for Staff Engagement

The mediation analysis showed that leadership behavior serves as the mechanism through which leadership identification influences staff engagement, based on the leader’s perception as captured by our study design. This indicates that merely identifying as a leader is insufficient to drive engagement; instead, leaders must actively engage in leadership behaviors to create meaningful impact. Furthermore, the moderation analysis demonstrated that workload significantly influenced the strength of the relationship between leadership behavior and staff engagement. Under high workload conditions, the effectiveness of leadership behaviors in fostering engagement may be compromised, likely due to increased cognitive and emotional strain on leaders.⁴⁹ Conversely, in high-pressure environments, strong leadership behaviors become even more crucial in mitigating the negative effects of excessive workload by providing emotional support, structuring team efforts effectively, and reinforcing team cohesion. This finding is consistent with job demands-resources (JD-R) theory, which

posits that leadership behaviors act as a critical resource in buffering against the detrimental effects of high job demands, including workload and emotional exhaustion.⁵⁰

Theoretical and Practical Implications

These findings contribute to the broader discussion on physician leadership by highlighting the interplay between identity, behavior, workload, and engagement. Unlike corporate or academic leadership models, where leadership identity often takes precedence, radiologists in leadership positions continue to see themselves primarily as physicians. This may have implications for leadership development initiatives, suggesting that effective programs should not only focus on skill-building but also address identity alignment. Leadership identity evolves throughout a physician's career, reinforcing the need for early and continuous leadership training.⁵¹ Moores advocates for embedding leadership education into medical training, ensuring physicians see leadership as intrinsic to their role.⁵¹ Early identity formation is crucial, as delays in exposure may lead to leadership being perceived as an imposed responsibility rather than a natural extension of clinical expertise.²¹ In the UK alone, radiology faces a growing crisis with imaging demands rising by ~5% annually, while workforce growth remains limited to ~2% per year. Leadership development is more critical than ever, as the current radiology workforce shortfall of 33% is projected to escalate to 44% by 2024, exacerbating workload pressures.⁵² Inclusive leadership strategies can enhance recruitment, retention, and workplace morale, mitigating burnout and workforce instability for radiologists.⁵³

Limitations and Future Research Directions

This study has several limitations. First, self-report measures introduce potential response bias and social desirability effects. Future research should include peer or staff evaluations for a more objective assessment. Second, the cross-sectional design prevents causal inferences, capturing leadership behavior and engagement at a single time point. Longitudinal studies are needed to track leadership identity and its long-term impact. Third, focusing solely on radiologists in German university hospitals limits generalizability to other medical specialties or healthcare settings. Leadership demands may vary across fields, particularly in procedural or patient-facing specialties. Future studies should examine these dynamics across diverse specialties to broaden insights into physician leadership. Finally, although we contacted all university hospital departments of radiology and neuroradiology in Germany, participation was voluntary and anonymous, and non-response may have introduced bias. This should be considered when interpreting the representativeness of the sample.

Conclusion

This study provides empirical evidence that leadership identification influenced staff engagement through leadership behaviors. However, consultant radiologists primarily identified as physicians, with leadership playing only a secondary role.

Abbreviations

β , Standardized Regression Coefficient; CI, Confidence Interval; EXQ, Employee Experience Questionnaire; GMPS, German Managerial Practice Survey; IQR, Interquartile Range; JD-R, Job Demands-Resources (theory); M, Mean; N, Number (sample size); p, Probability value; r, Pearson Correlation Coefficient; SD, Standard Deviation; SE, Standard Error; SPSS, Statistical Package for the Social Sciences.

Data Sharing Statement

The datasets generated and/or analyzed during the current study are not publicly available due to institutional data security regulations but may be made available from the corresponding author on reasonable request and subject to approval by our institutional data security department.

Author Contributions

J.N., C.G., E.C., S.M.N. made a significant contribution to the conception of the work reported, study design (J.N., C.G.), execution (J.N., C.G.), acquisition of data (J.N.), analysis and interpretation (J.N., C.G.); took part in drafting (J.N., C.G.);

in particular, J.N. contributed to all phases of the study, including conception, data collection, analysis, drafting, revision, and project administration. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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