RESEARCH ARTICLE

EQUITY, DIVERSITY, AND INCLUSION

Gender-focused training improves leadership of female medical students: A randomised trial

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Abstract

Objectives: Recent research suggests that the gender of health care providers may affect their medical performance. This trial investigated (1) the effects of the gender composition of resuscitation teams on leadership behaviour of first responders and (2) the effects of a brief gender-specific instruction on leadership behaviour of female first responders.

Methods: This prospective randomised single-blinded trial, carried out between 2008 and 2016, included 364 fourth-year medical students of two Swiss universities. One hundred and eighty-two teams of two students each were confronted with a simulated cardiac arrest, occurring in the presence of a first responder while a second responder is summoned to help. The effect of gender composition was assessed by comparing all possible gender-combinations of first and second responders. The gender-specific instruction focused on the importance of leadership, gender differences in self-esteem and leadership, acknowledgement of unease while leading, professional role, and mission statement to lead was delivered orally for 10 min by a staff physician and tested by randomising female first responders to the intervention group or the control group. The primary outcome, based on ratings of video-recorded performance, was the first responders' percentage contribution to their teams' leadership statements and critical treatment decision making.

Results: Female first responders contributed significantly less to leadership statements (53% vs. 76%; $P = 0.001$) and critical decisions (57% vs. 76%; $P = 0.018$) than male first responders. For critical treatment decisions, this effect was more pronounced ($P = 0.007$) when the second responder was male. The gender-specific intervention significantly increased female first responder's contribution to leadership statements ($P = 0.024$) and critical treatment decisions ($P = 0.034$).

Conclusions: Female first responders contributed less to their rescue teams' leadership and critical decision making than their male colleagues. A brief gender-specific

leadership instruction was effective in improving female medical students' leadership behaviours.

1 | INTRODUCTION

From a patient's perspective, the gender of one's health care providers should be of no concern. However, research indicates that the gender of health care providers may affect their performance while specific task requirements might determine which gender outperforms the other.[1-5] The underlying mechanisms of gender-related differences in health care provision are currently not well understood. Investigating gender-related differences is thus necessary to ensure high-quality health care regardless of the gender of the providers and to develop appropriate interventions if necessary.

Co-ordinating team activity and making timely decisions in medical emergencies requires decisive,[6,7] directive[8] and 'task-oriented'[9] leadership. This leadership style is also termed 'agentic'.[10] Prevalent gender stereotypes regard agentic behaviour as masculine, whereas 'communal' behaviour (e.g., affectionate, kind and interpersonally sensitive) is regarded as feminine. Thus, females have leadership advantages when more communal behaviour is required (e.g., fostering team cohesion).[3-5,10] Although gender stereotypes have changed in recent years, a large gender gap remains with regard to the agentic behaviour.[11]

Stereotype threat can be defined as a disruptive psychological state that people experience when they feel at risk for confirming a negative stereotype associated with their social identity.[12] A stereotype treat can trigger feelings of uneasiness, a stress response, and increased monitoring of self-relevant information and signs of failure.[10,13] These processes can impede performance, and hence confirm the stereotype, and may result in trying to avoid situations that require such behaviour altogether.[14] Role congruency theory also refers to such descriptive stereotypes (i.e., what women *can* do) but additionally also to prescriptive gender stereotypes (i.e., what women *should* do).[10,15] Both stereotype threat and role congruency theory predict that females may be more hesitant to assume agentic leadership. Note that leadership stereotypes refer to perceived rather than actual competence and even highly competent women may be reluctant to behave against the leadership role stereotype. If no lack of competence is involved, rather small interventions may suffice to mitigate the effects of role stereotypes.[16] Such interventions could entail encouraging more positive views of one's agentic abilities, making the pernicious effects of stereotyping transparent, or assuring participants that the situation is safe for trying out an uncommon leadership role.[14,16-18]

Given the frequent and unpredictable occurrence of cardiac arrests, pre-graduate training and continuous medical education must ensure that all physicians are able to act as competent first responders in cardiopulmonary resuscitation (CPR). Besides technical skills, human factors such as teamwork and also leadership are relevant for high-quality CPR.[6,19-26] However, shortcomings in leadership and CPR performance remain a common problem, even for well-trained health care providers.[23,26-31] Simulator-based studies reported less efficient leadership and performance of female rescuers compared with their male colleagues, especially in mixed-gender groups.[1,2]

The current study aimed to gain further insight into gender-related CPR performance in several respects: first, to test if the gender differences in leadership behaviour identified in previous studies[1,2] still persist in a domain where now a majority of students are female and second, to test the hypothesis that a brief gender-specific intervention will improve the leadership behaviour of female medical students. Methodologically, the study aimed at investigating such processes by observing actual leadership behaviour in a scenario that, despite its simulation character, reflects a medically relevant situation in a highly realistic way.[31]

2 | METHODS

2.1 | Participants

The study was conducted between December 2008 and June 2016 in the simulation centre of the intensive care unit (ICU) at the University Hospital Basel, Switzerland. Voluntary workshops were offered to fourth-year medical students at the Universities of Basel and Zurich. Workshops were conducted with six participants each, and whenever possible, were organised as all-female, all-male, or three females and three males. The participants were blinded towards the goal of the study. As part of their medical school curricula, the students were already proficient in basic life support (BLS), including automatic external defibrillators (AED), before participating in the simulator training.

2.2 | Ethics

The study was conducted in accordance with the guidelines of the Helsinki Declaration and approved by the local ethics committee of the institutional review board (Ethics Committee northwest/central Switzerland, EKNZ, www.eknz.ch). Furthermore, written consent was obtained from all participants.

2.3 | Simulator

A patient simulator (Meti SimMan 2, Laerdal, Norway) was used. The voice of a member of the simulator team was broadcasted using a

loudspeaker in the mannequin's head, allowing interactive communication. The electrocardiogram (ECG) was continuously displayed on a standard ICU monitor. Standard advanced life support equipment and medication were available in the simulator room. To prevent equipment-related issues from influencing the results, a confederate nurse instructed to display a helpful manner but to be active on command only was present during the simulations. All participants received standardised instructions regarding the features of the simulator.

2.4 | Design

This is a randomised controlled single-blinded trial (Figure 1). It included a pre-trial intervention for all participants followed by the trial scenario. Randomisations were performed using computer-generated numbers. Video recordings were used for video-assisted debriefings and data analysis. The trial addressed two research questions:

1. The effects of the gender composition of resuscitation teams on the leadership behaviour of first responders. This was addressed

by comparing all four possible gender combinations in teams with a first and a second responder (female–female, female–male, male–female and male–male).

2. The effects of a gender-specific leadership intervention on the leadership behaviour of female first responders. This was addressed by randomising the female first responders to a gender-specific intervention (intervention group) or no intervention (control group).

2.5 | Pre-trial intervention

The pre-trial interventions aimed to bring all participants to the same level of CPR competence. The six participants of each workshop were randomly allocated to two teams of three and confronted with a simulated witnessed cardiac arrest scenario occurring in the presence of the complete team of three. The two teams performed the scenario one after the other. Thereafter, a 20-min video-assisted debriefing based on current ILCOR resuscitation guidelines[32] was conducted by an experienced physician (SH or SM) in the presence of all six participants.
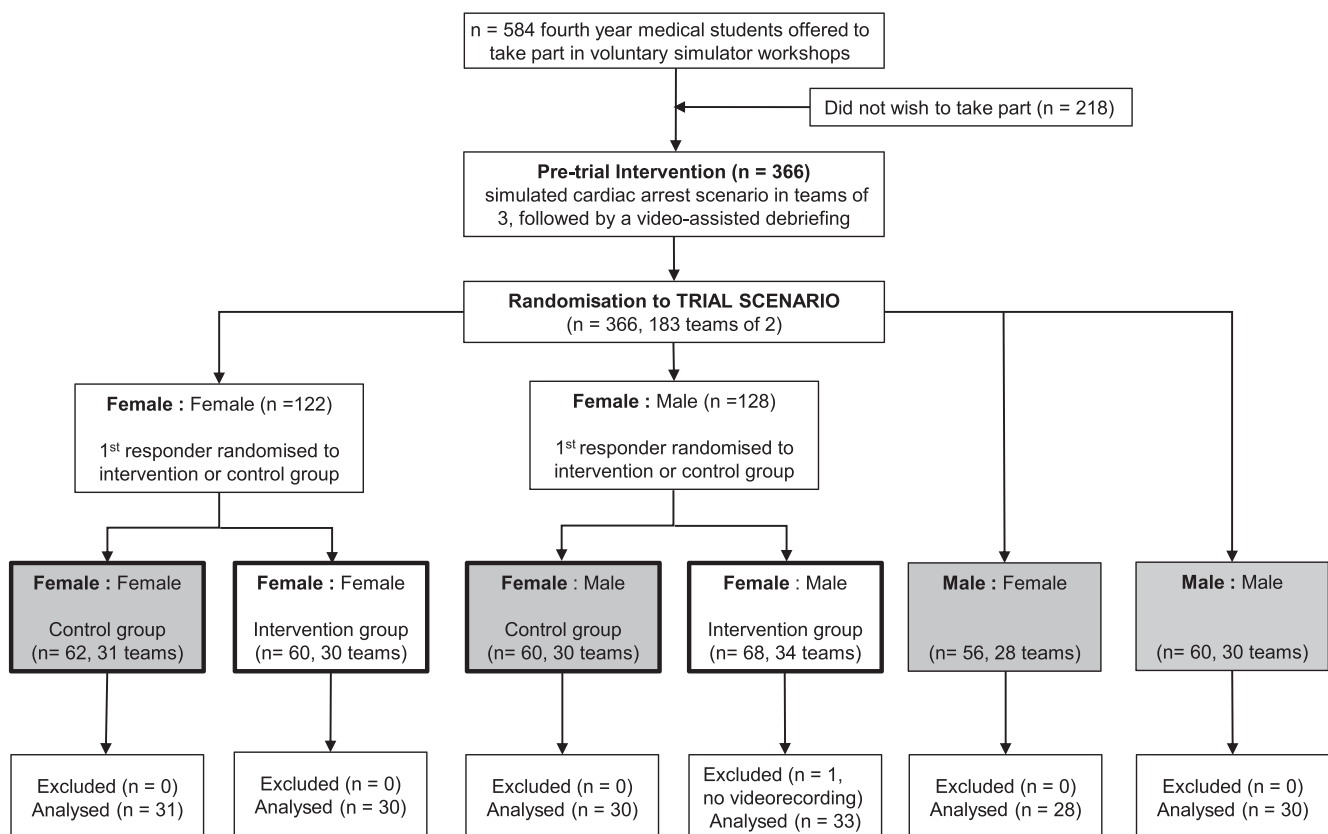
FIGURE 1 Consort flow chart. Grey shaded boxes denote the four groups without a gender-specific intervention used to investigate the effects of the gender composition of teams; bold-framed boxes denote the four groups used to investigate the effects of the gender-specific intervention; in each group, the gender of the first responder, that is, the person witnessing the cardiac arrest in the role of the treating physician, is indicated in bold

3 | TRIAL SCENARIO

Participants were randomised into *new* teams of two for the subsequent trial scenario, assuring that they had performed the pre-trial simulated scenario in different teams. Thus, ensuring that:

1. Both team members had an equal level of CPR competence and an equal familiarisation with the simulator environment.
2. Both team members were aware of having equal knowledge of the task requirements and the environment.
3. Potential effects of team members having previously performed the same task together were avoided.

In each trial scenario, one of the two members was randomly assigned to be the first responder who witnessed the cardiac arrest. The remaining team member acted as the second responder who had to enter the room when the first responder calls for help. The designated first responder had to assess a 23-year-old male patient (simulator) presenting with wrist pain after a syncopal event. Two minutes into the encounter, the patient developed cardiac arrest (sudden loss of consciousness, closed eyes, apnoea and no palpable pulses) due to ventricular tachycardia displayed on the ECG monitor. The second responder was subsequently called to help. Regardless of the teams' performance, the patient remained in cardiac arrest for 5 min (trial observation period). Thereafter, a return to spontaneous circulation occurred upon defibrillation.

3.1 | Gender-specific intervention

Female team members assigned to the role of the first responder in the trial scenario were further randomised to a gender-specific intervention (Box 1) (intervention group) or no intervention (control group). In the absence of an available tool in the literature, we developed a set of instructions that covered a variety of potential mechanisms for gender differences in leadership (e.g., awareness of the problem,[1,2,6,21] gender difference in self-esteem,[33] and acknowledgment and legitimation[10,17]) and could be given during a time interval of 10 min. The intervention was tested in pilot experiments; it consisted of seven key issues, ended with a clear mission to lead in the next emergency scenario, and was provided immediately before the trial scenario by an experienced critical care physician (SH - female and/or SM - male) according to a checklist (Box 1). Data S1 includes a detailed description of the setting and conduct of gender-specific intervention and a verbatim transcript.

3.2 | Data analysis

According to a predefined protocol, data analysis was performed on video recordings by two independent raters. Verbatim transcripts of the communication were prepared, and the number of utterances of each participant was noted. Each utterance was then coded as

BOX 1 The gender-specific leadership intervention

Component	Explanations and instructions given
Repetition	Leadership is crucial in emergency situations.
Awareness of the problem	Females tend to lead less than their male colleagues despite similar (or even better) medical knowledge.
Gender difference in self-esteem	Females underestimate themselves more often than their male colleagues.
Acknowledgement and legitimation	You may not lead because it makes you feel uncomfortable. It is perfectly acceptable to feel uncomfortable while leading.
Professional role	Your role is to take the lead in emergency situations because it is in the best interest of your patient.
Know-how	Leading in emergency situations is deciding what to do next, telling your co-workers what they have to do, and making sure the patient receives the optimal therapy.
Mission	The next time(s) you are confronted with an emergency situation I want you to take the lead.

'leadership statement' or 'utterance unrelated to leadership' according to predefined categories based on the adapted Leadership Behaviour Description Questionnaire (Data S2).[21,23] The number of leadership statements is a quantitative measure of leadership. To assess qualitative aspects of leadership, we used the term 'critical treatment decision', defined as a leadership statement relating to a small number of highly relevant aspects in the context of CPR. Hence, critical treatment decisions form a subgroup of the total leadership statements. The following statements were coded as critical treatment decisions: the decision to start CPR (e.g., 'We have to start CPR now.', attainable only once), the decision to start chest compressions (e.g., 'Start chest compressions now!', attainable only once), the decision to resume chest compressions after defibrillation (e.g., 'Please continue chest compressions.', attainable multiple times) the decision to start ventilation (e.g., 'Begin bag-mask ventilation.', attainable only once), the decision to perform defibrillation (e.g., 'Defibrillate now.' attainable multiple times), or decision to administer epinephrine (e.g., 'Give adrenaline now.', attainable only once). A critical treatment decision was also awarded to participants performing one of the aforementioned tasks spontaneously without prior request by the other team member.

Followership may depend on gender-specific biases and may affect leadership. Accordingly, for each leadership statement, 'followership' was coded if the person addressed by a leadership statement performed as requested and expressed as the percentage of leadership statements received. Discrepancies in behavioural codings (leadership and followership) were solved by jointly reviewing the video recordings in the presence of one senior author (SH).

The presence or absence of CPR-related performance (i.e., chest compression, ventilation defibrillation and injection of drugs) was coded for each second. Differences of ≤5 s in the timing of events

were considered to represent inter-rater agreement, and the smaller value was used for further analysis. Differences of ≥5 s were solved by jointly reviewing the video recordings. The following measures were used to assess the technical quality of CPR: hands-on time, time to start resuscitation, time to first defibrillation, time to first epinephrine injection and chest compression rate. Hands-on time was defined as the cumulative time of chest compressions and expressed as percentage of the total time available for chest compressions. Interruptions in chest compression ≤5 s for ventilation and ≤10 s for defibrillation were counted as uninterrupted hands-on time.

3.3 | Outcomes

The primary outcome was the percentage contribution of the first responder to his/her team's leadership. This contribution was calculated separately for both leadership statements and critical treatment decisions during the first 5 min of cardiac arrest (trial observation period): leadership statements of the first responder divided by all leadership statements of both team members times 100. Thus, the contribution of first responders taking all decisions themselves is 100%, whereas equally shared leadership between both team members results in a contribution of 50%. A power analysis based on pilot experiments revealed that approximately 30 teams had to be studied in each group to detect a between-group difference of 10% in the primary outcome with a significance level of 0.05 and 80% power.

Prespecified secondary outcomes were measures of CPR performance, further aspects of leadership of the first and second responders, and followership to leadership statements.

3.4 | Statistics

Statistical analysis was performed using version 25 of SPSS (International Business Machines Corp., Armonk, USA). Percentage data were analysed after arcsine transformation. Because data were not normally distributed, they are reported as medians [interquartile range (IQR)] unless stated otherwise and analysed using nonparametric analysis of variance (Kruskal–Wallis test) followed by Mann–Whitney U tests if appropriate. Estimates of differences between medians and their 95% confidence intervals (CI) were obtained by Hodges–Lehmann's independent samples median tests. A $P < 0.05$ (two-tailed) was considered as statistically significant.

4 | RESULTS

4.1 | Participants

Data of 182 teams were analysed and reported (consort flow diagram, Figure 1).

4.2 | Research question 1: Effects of the gender composition of teams

Research question 1 was addressed using data of the 119 teams with all possible gender combinations (31 female–female, 30 female–male, 28 male–female and 30 male–male teams; grey-shaded boxes in Figure 1).

4.2.1 | Primary outcome

Female first responders contributed significantly fewer leadership statements (53% vs. 76%; estimate of difference between medians 17; 95% CI 7–26; $P = 0.001$) and critical treatment decisions (57% vs 76%; estimate of difference between medians 14; 95% CI 0–23; $P = 0.018$) than male first responders (Table 1). When the second responder was male, this effect was more pronounced for critical treatment decisions (47% in female–male teams vs. 78% in female–female teams; estimate of difference between medians 21; 95% CI 5–36; $P = 0.007$) but not for the leadership statements (50% in female–male teams vs. 54% in female–female teams; estimate of difference between medians 10; 95% CI −4 to 23; $P = 0.23$). By contrast, the contribution of male first responders to leadership statements (74% in male–female teams vs. 78% in male–male teams; estimate of difference between medians 2; 95% CI −15 to 9; $P = 0.67$) and critical treatment decisions (67% in male–female teams vs. 80% in male–male teams; estimate of difference between medians 7; 95% CI 0–24; $P = 0.23$) was not affected by the gender of the second responder.

4.2.2 | Secondary outcomes

Data on team performance are displayed in Table 2. There was no difference between female and male first responders in the number of utterances unrelated to leadership (18 vs. 19; estimate of difference between medians 1; 95% CI −1 to 3; $P = 0.67$). Thus, female students were not simply more silent overall. The timing of the first leadership statements of the team and of the first responder is displayed in a Kaplan–Meier plot (Figure 2). Note that after approximately 15 s, first responders' curves start to climb less steep than the teams' curve, which results from second responders stepping in to take the lead. This effect is more pronounced in teams with a female first responder ($P = 0.046$; logrank test). However, regardless of the gender of the first and second responders ($P = 0.71$), second responders stepped in after 15 [11–21] seconds if the first responder made no leadership statement. Moreover, regardless of the first responder's gender, the timing of the first leadership utterance was negatively associated with that person's contribution to leadership (Pearson coefficient −0.49; 95% CI −0.62 to −0.34; $P < 0.0001$) and critical treatment decisions (Pearson coefficient −0.45; 95% CI −0.59 to −0.30; $P < 0.0001$). In other words, the earlier first responders made their first leadership statement, the larger their contribution to the team's leadership.

TABLE 1 Performance of the first and second responders

	Female–female (n = 31)	Female–male (n = 30)	Male–female (n = 28)	Male–male (n = 30)	P value
First responder					
Contribution to total number of team leadership statements, median [IQR], %	54 [38–86]	50 [36–70]¶	74 [54–87]	78 [57–91]	0.007
Contribution to critical treatment decisions, median [IQR], %	78 [43–88]	47 [33–60]*	67 [46–95]	80 [50–100]	0.004
First in team to speak, n	23/31	19/30	20/28	20/30	0.80
First in team to make a leadership statement, n	23/31	19/30	24/28	24/30	0.23
First in team to make a critical treatment decision, n	22/31	18/30	23/28	23/30	0.27
First utterance, median [IQR], s	4 [3–7]	4 [3–5]	4 [2–5]	4 [3–6]	0.59
First leadership statement, median [IQR], s	12 [4–19]	21 [11–28]*	13 [7–17]	11 [7–19]	0.015
First critical treatment decision, median [IQR], s	15 [7–35]	25 [11–26]*	14 [8–29]	13 [8–20	0.011
Colleague's commands followed, median [IQR], %	100 [80–100]	100 [86–100]	100 [75–100]	100 [100–100]	0.32
Second responder					
Colleague's commands followed, median [IQR], %	100 [89–100]	91 [86–100]**	89 [79–100]**	100 [90–100]	0.032
First leadership statement, median [IQR], s					
If second in team to lead	26 [19–69]	24 [12–41]	28 [20–63]	53 [31–110]*	0.013
If first in team to lead	19 [13–29]	17 [11–21]	17 [13–24]	13 [11–20]	0.71
No leadership statement made, n	0/31	0/30	2/28	2/30	0.23
First critical treatment decision, median [IQR], s					
If second in team to crit. decide	40 [25–97]	34 [17–56]	30 [22–67]	54 [34–141]	0.21
If first in team to crit. decide	21 [12–34]	22 [17–27]	24 [20–36]	13 [11–27]	0.62
No critical decision made, n	3/31	1/30	4/28	7/30	0.18

Note: Values are medians [IQR].

Abbreviation: IQR, interquartile range.

*$P < 0.05$ versus all other groups. **$P < 0.05$ between mixed-gender versus same-gender teams. ¶$P < 0.05$ versus teams with male as first person present.

Followership of second responders, that is, acting as requested by leadership statements of first responders, was extremely high (100 [87–100] %), regardless of the gender of the first and second responders ($P = 0.92$). Thus, the observed gender differences in leadership do not result from gender-related differences in followership.

4.3 | Research question 2: Effects of the gender-specific intervention

Research question 2 was addressed using data of the 124 teams with a female first responder (61 female–female and 63 female–male teams; bold-framed boxes in Figure 1).

4.3.1 | Primary outcome

The gender-specific intervention resulted in a significant increase in female first responders' contribution to their team's leadership statements (53% in the control group vs. 69% in the intervention group; estimate of difference between medians 11; 95% CI 3–21; $P = 0.011$) and critical treatment decisions (57% in the control group vs. 73% in the intervention group; estimate of difference between medians 13; 95% CI 0–20; $P = 0.029$). Though this increase was quantitatively similar regardless of the gender of the second responder, a negative effect of male presence on female first responders' contribution to leadership statements (60% in female–male teams vs. 77% female–female teams; estimate of difference between medians 13; 95% CI 2–22; $P = 0.029$) and critical treatment decision taking (67% in female–male teams vs. 80% female–female teams; estimate of difference between medians 17; 95% CI 0–27; $P = 0.017$) persisted.

4.3.2 | Secondary outcomes

The gender-specific intervention had no further effects on secondary outcomes, namely, measures of the quality of CPR and leadership or followership patterns of the first and second responders.

TABLE 2 Team performance

	Female–female (n = 31)	Female–male (n = 30)	Male–female (n = 28)	Male–male (n = 30)	P value
Hands-on time, median [IQR], %	80 [77–88]	84 [78–88]	82 [78–90]	81 [76–85]	0.55
Time to start resuscitation, median [IQR], s	31 [20–44]	42 [33–48]**	44 [26–57]**	34 [28–42]	0.018
Time to first defibrillation, median [IQR], s	68 [55–105]	86 [68–142]	100[66–153]	90 [60–147]	0.18
Time to first epinephrine, median [IQR], s	130 [113–171]	110 [87–168]	119 [95–177]	131 [95–200]	0.52
Chest compression rates, median [IQR], comp/min	110 [90–120]	108 [100–116]	111 [99–116]	111 [102–120]	0.97
Total number of leadership statements, median [IQR], n	13 [11–15]	16 [13–20]**	15 [13–20]†	12 [10–14]	<0.001
Critical treatment decisions, median [IQR], n	6 [5–6]	7 [6–9]*	6 [5–7]†	5 [5–6]	0.001
First utterance, median [IQR], s	4 [2–5]	3 [2–5]	3 [2–5]	3 [2–4]	0.81
First leadership statement; median [IQR], s	11 [4–16]	14 [9–21]	12 [7–17]	11 [7–17]	0.20
If made by first person present	7 [4–13]	12 [9–21]	11 [7–16]	10 [7–16]	0.17
If made by second person present	19 [13–25]‡	17 [11–26]	17 [13–24]	13 [11–20]	0.71
First crit. treatment decision, median [IQR], s	12 [7–26]	18 [11–26]	14 [8–24]	12 [7–17]	0.12
If made by first person present	12 [4–22]	13 [9–22]	13 [8–23]	11 [7–16]	0.57
If made by second person present	22 [13–35]	25 [18–33]‡	30 [16–41]	13 [11–20]	0.19

Note: Values are medians [IQR].
Abbreviation: IQR, interquartile range.
*P < 0.05 versus all other groups. **P < 0.05 between mixed-gender versus same-gender teams. †P < 0.05 versus male-male teams.
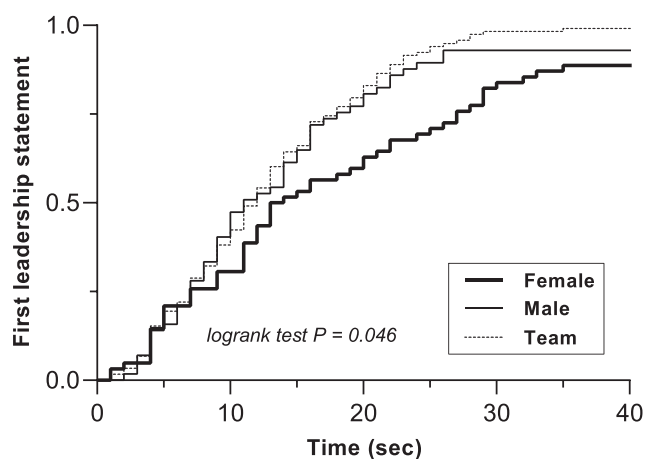‡P < 0.05 versus teams with male as first person present.

FIGURE 2 Timing of first leadership statement. Kaplan–Meier plot displaying the probability of the timing of the first leadership statement of female (n = 61; thick line) and male (n = 58; thin line) first responders during a simulated cardiac arrest. The dotted line represents the timing of the first within team leadership statement in all 119 teams regardless of whether it came from the first or second responder. Note that after approximately 15 s, first responders' curves (solid lines) start to climb less steep than the teams' curve (dotted line), which results from second responders stepping in to take the lead. This effect is more pronounced in teams with a female first responder (P = 0.046; logrank test)

5 | DISCUSSION

In this randomised controlled trial, we investigated the effects of the gender composition of resuscitation teams on the leadership behaviour of the first responder and the effects of a gender-specific leadership intervention on female first responders. Female first responders contributed less to their teams' total leadership statements and critical treatment decision making than male first responders. This difference was more pronounced when the second responder was male. A gender-specific leadership intervention significantly improved the contribution of female first responders to their teams' leadership and critical treatment decision making; this effect was less pronounced when the second responder was male. To the best of our knowledge, this is the first trial testing a gender-specific intervention on individual leadership in a medical context.

Great care was taken to isolate leadership from potential confounders: The setting was unambiguous in that the first responder (witnessing cardiac arrest in the role of the attending physician) rather than the second responder (summoned to help an unknown patient) was expected to take the lead. A pre-trial intervention was conducted to equalise knowledge and skills, make the participants aware of their now equal level of knowledge and skills, and achieve an equal familiarisation with the simulated environment. Despite eliminating these potential confounders, female first responders contributed less to their team's leadership than their male colleagues, confirming prior observations.[1,2] Regardless of the gender composition, the overall quality of CPR of our student teams was high, which is likely due to the pre-trial intervention. Compared with previously published results from our simulation centre, all relevant CPR performance measures were at least similar and partly even better than those of experienced physicians (e.g., percentage of hands-on times from 52% to 69%),[23,29] and significantly better than those of other medical students (e.g., percentage of hands-on times from 48% to 66%),[1,24] performing

in almost identical scenarios, albeit without a pre-trial intervention. Moreover, median percentage hands-on times (84%) in the present study exceeded the threshold of 81% above which no further survival benefit may be expected.[34]

The observed difference between the genders appears to be specific for leadership, as female first responders were not simply more silent overall. There was no evidence for second responders taking over leadership prematurely, that is, before giving first responders a chance to lead. By contrast, regardless of the gender of both rescuers involved, the leadership of first responders remained unchallenged provided their first leadership statement was made promptly. However, if leadership by the first responder was absent or delayed, the second responder took over. The term 'leadership vacuum' has been used to describe the absence of effective leadership in resuscitative medicine.[35] In our cohort of medical students, second responders tolerated the absence of the first responder's leadership, that is, a perceived leadership vacuum, for approximately 15 s. After this time interval, and regardless of the genders of first and second responders, the second responder usually stepped in to take over leadership. Thus, team members compensate for the shortcomings of their leader, as evidenced by the constant absolute number of a team's leadership statements. Although encouraging, this makes conclusions on individuals' leadership performance based on retrospective real-life data difficult.[36]

Strengths of the present study include the prospective randomised and single-blinded design, the comparatively large cohort and the identical conditions for all participants. Limitations relate to the absence of actual patients and the participants being medical students without experience as medical professionals. Thereby, our results might not be generalizable to more experienced rescuers. As our gender-specific intervention consists of a bundle of seven different components, our data do not allow conclusions regarding the relative importance of individual intervention components. In future trials, this effect of a gender-specific intervention could be enhanced by adding a time-limit instruction for the first leadership statement.

Our trial has several implications. First, regardless of the gender of our medical student participants, our pre-trial intervention resulted in a technical quality of CPR at least equivalent to that of experienced physicians. However, this successful teaching of medical competencies did not ensure adequate leadership skills. Thus, it cannot be taken for granted that extensive technical training will translate in enhanced leadership of female physicians. Therefore, more experienced female physicians might benefit from additional gender-specific teaching in leadership also. Moreover, the teaching of leadership skills for both genders should emphasise an early leadership statement to establish one's leader role and prevent a leadership vacuum as already routinely done in similar high liability environments, like airplane pilot-communication.[37]

Second, gender bias and gender stereotypes are relevant in medicine.[10,14,17,38–41] A brief intervention combining awareness of such biases and stereotypes with a mission statement towards leadership had a marked positive effect. Similar interventions, tailored to the specific context, might thus be a promising avenue in other medical settings.

Third, this and other trials[1–5] indicate that the gender of health care providers may affect the quality of their performance and that the medical context and/or task requirements might determine whether and which gender outperforms the other. Exploring and addressing gender-related differences is a necessary first step to assure a high level of performance regardless of the gender of health care providers.

6 | CONCLUSIONS

Female medical students acting as first responders in resuscitation teams contributed less to their team's leadership statements and critical treatment decision making than male medical students. A brief gender-specific leadership instruction for females led to a significant increase in their contribution to leadership and critical decision making.

ETHICAL APPROVAL

The study was conducted in accordance with the guidelines of the Helsinki Declaration and approved by the local ethics committee of the institutional review board (Ethics Committee northwest/central Switzerland, EKNZ, www.eknz.ch). Furthermore, written consent was obtained from all participants.

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