



# Self-Confidence in Endotracheal Intubation Among Pediatric Interns: Associations With Gender, Experience, and Performance

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## ABSTRACT

**BACKGROUND AND OBJECTIVE:** Supervisors' decisions regarding procedural readiness are influenced by resident confidence. Confidence is a valuable metric if we understand how it correlates with trainee characteristics and procedural competence. Our objective was to evaluate the relationship between self-reported confidence in endotracheal intubation (ETI) and pediatric interns' characteristics (gender, prior intubation experience) and performance (airway management knowledge, demonstrated skills on airway trainers).

**METHODS:** This was a secondary analysis of a randomized, controlled trial of an airway management curriculum. Gender and prior intubation experience were reported on a preparticipation questionnaire. Interns' performance was measured 1) using a 14-item knowledge-based assessment of airway management and 2) as time to successful intubation across 4 simulated intubation scenarios. After completing the curriculum and assessment, interns reported retrospective precurriculum and current postcurriculum confidence with ETI using a 10-point Likert scale.

**RESULTS:** Forty-nine interns participated, of whom 16 (33%) were male. Eleven (22%) had  $\geq 1$  previous successful

intubation. Median [interquartile range] pre- and postcurriculum confidence scores were 3 [2, 5] and 6 [5, 8], respectively. Male interns reported higher precurriculum confidence than females (median difference: 2.0; 95% confidence interval: 0.1, 3.9); postcurriculum confidence among males was also higher but not statistically significant. There was no correlation between self-reported precurriculum confidence and prior experience. There was no correlation between pre- or postcurriculum self-reported confidence and performance on the knowledge-based assessment or time to successful intubation on airway trainers.

**CONCLUSIONS:** Male pediatric interns self-report higher initial confidence in ETI compared to females. Self-reported confidence did not correlate with prior experience, airway management knowledge, or intubation performance on airway trainers.

**KEYWORDS:** confidence; competence; endotracheal intubation; residency

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## WHAT'S NEW

We found that pediatric interns' self-reported confidence in endotracheal intubation did not correlate with experience, knowledge or performance, but males self-reported higher confidence compared to females. This is important for supervisors, whose decisions regarding procedural readiness are influenced by resident confidence.

MERRIAM WEBSTER DEFINES self-confidence as “confidence in oneself and in one's powers and abilities.”<sup>1</sup> For health professionals, self-confidence captures a providers' belief that they possess a required knowledge set or procedural skill.<sup>2</sup> It is a commonly used self-assessment metric throughout medical training. Degree

of self-confidence may impact willingness to undertake a task or to ask for help.<sup>3,4</sup> Competence, on the other hand, represents proficiency in putting knowledge or skills into practice.<sup>5–7</sup> Prior literature has shown that confidence and competence are not always well-understood and often used interchangeably although they are not synonymous. While competence can be objectively measured, confidence is inherently subjective. Furthermore, confidence is not always congruent with, or reflective of, competence.<sup>5,8–11</sup> This may be particularly true for the trainees with the least skill or experience, a phenomenon referred to as the Dunning Kruger effect.<sup>12</sup>

In its Common Program Requirements, the Accreditation Council for Graduate Medical Education sets the goal of residents achieving “sufficient competence to enter practice without direct supervision” by the end of their

training.<sup>13</sup> Prior to residents achieving such independence, supervisors' decisions about when to allow trainees to perform tasks related to patient care and procedures are ideally based on established level of competence.<sup>14</sup> In reality, information on prior performance is often not available, and supervisors may be forced to rely on other factors when making decisions about entrustment.<sup>15,16</sup> Trainees' self-confidence in their clinical or procedural skills has been shown to influence supervisors' impression of readiness even though confidence and competence are not always concordant.<sup>14</sup> For confidence to be a useful metric in guiding decisions around supervision and entrustment, it is important to understand how trainee characteristics impact trainees' self-confidence and the correlation between their self-confidence and their competency in terms of knowledge and skills. This is particularly important for infrequently performed procedures where opportunities for supervisors to assess competence are rare. Such is the case for pediatric intubation, which has become an infrequently performed procedure by pediatric residents.<sup>17</sup>

The goal of our study is to evaluate the relationship between pediatric interns' self-reported confidence in endotracheal intubation and their characteristics (gender and prior intubation experience) and performance (airway management knowledge and demonstrated procedural skills on airway trainers).

## METHODS

This was a secondary analysis of a randomized, controlled educational trial of an airway management curriculum for pediatric interns. The primary study aimed to determine the effect of integrating prerecorded videos of patient endotracheal intubations on pediatric intubation performance.<sup>18</sup> The study was conducted between January 2015 and June 2016. Baseline data were collected on age, gender and number of prior successful intubations. The control group received a standard didactic curriculum comprised of bulleted text and still images, while the intervention group received a didactic curriculum covering the same material but integrating 9 video clips from real-life intubations. Identical content was covered in the 2 curricula: pediatric physiology and airway anatomy, advanced airway equipment, indications for intubation, direct laryngoscopy and intubation techniques, and potential procedural complications. Didactic instruction was delivered in an initial 30 minute session (Session 1). Within the same week as the initial session, participants had a second session (Session 2) that began with a 5 minute recap of the prior didactic session. After this review, residents in both groups underwent 15 minutes of standardized simulation instruction using airway trainers. Further details of the curriculum have been previously published.<sup>18</sup>

Interns' performance was measured in 2 ways at the end of Session 2. First, the study assessed intubation skills following participation by measuring time to successful intubation (TTSI) on 4 simulated airway scenarios. These

involved intubation with easy and difficult airways on infant and child-size trainers; the participating interns were exposed to the easy trainers during the simulation instruction but had no exposure to the difficult trainers prior to the assessment. Each intern was assessed on all 4 scenarios in the same order. We defined TTSI as the cumulative time required for correct placement of the endotracheal tube for a given scenario, regardless of the number of intubation attempts. As a second means of assessment, we compared performance on a 14 item knowledge-based assessment that interns completed prior to the teaching Session 1 and then again after they had received the curriculum. The questions and correct answers were derived through consensus among 3 national airway experts. A post-hoc power analysis found that given the sample size of 49 interns (with 16 males and 33 females), we had 92% power to detect a mean confidence score difference of 2 points using a 2-sided Wilcoxon rank sum test, assuming a pooled standard deviation of 2 and an alpha level of 0.05. Power was reduced to 85% when assuming samples sizes of 11 and 38 (ie, interns with and without prior intubation experience).

Immediately after completing both the knowledge-based and the simulated skills-based assessments in Session 2, interns were asked to report their retrospective pre-curriculum and current postcurriculum confidence in performing intubation using a 10-point Likert scale (1 = not confident at all, 10 = extremely confident). The inclusion of a retrospective confidence measure—referring to the assessment of confidence at an earlier (in this case pretraining intervention) moment—minimizes the impact of changes in intern self-assessment standards over time as they experience a shift in their frame of reference. This phenomenon of shifting self-assessment standards is called response-shift bias.<sup>19</sup> The methodology of using concurrent retrospective preintervention and current postintervention self-assessment is a validated method in the literature that has been shown to improve learners' reflection on their own knowledge and attitudes.<sup>20–23</sup>

## DATA ANALYSIS

To capture prior experience with intubation as a categorical variable, we classified any intern with 1 or more prior successful intubations as having intubation experience. To describe the distribution of confidence, we calculated medians with interquartile ranges of the pre- and postcurriculum scores.

To assess the association between confidence scores and intern characteristics, we calculated the median difference with 95 percent confidence intervals (95% CI) in confidence scores between gender and prior intubation experience subgroups using quantile regression models (with the confidence score as the dependent variable and the intern characteristic as the independent variable). We assessed the association between confidence scores and interns' performance on the knowledge-based assessment with Spearman's correlation. To test the association between confidence scores and interns' performance on the simulated airway scenarios, we used TTSI as our

measure of intubation performance. We estimated Cox proportional hazard regression models with TTSI as the dependent variable and confidence score as the independent variable, adjusting for mannequin characteristics (easy vs difficult and infant- vs child-size). Survival methods with censored observations were used to accommodate instances when the intern was not able to complete the intubation. Since each participant contributed 4 observations to the proportional hazard analysis (1 for each of the 4 intubation scenarios), these models used clustered sandwich standard error estimates, which allowed for intraparticipant correlation. As a sensitivity analysis we examined our hypotheses (using quantile regression for gender, prior intubation experience and knowledge-based assessment and a Cox model for the TTSI outcome) while including intervention type (video-enhanced vs standard curriculum) as a covariate.

This study was approved by the Institutional Review Board (IRB), and we obtained informed consent from all participants. Study data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at Boston Children's Hospital. REDCap is a secure, web-based application designed to support data capture for research studies. We used Stata v 13.1 (College Station, Tex) for all statistical analyses.

## RESULTS

Characteristics of the 49 interns enrolled in the study are shown in [Table 1](#). Sixteen of the 49 interns (33%) were male. Thirty eight of the 49 interns (78%) reported no prior successful intubations during clinical care, while 22% reported at least one prior successful intubation; 15% of females (5 of 33) and 38% of males (6 of 16) had  $\geq 1$  prior successful intubation (not a significant difference,  $P = .08$ ). Across the full study sample, median retrospective precurriculum confidence was 3 (interquartile range 2–5). Male interns reported higher precurriculum confidence (median 4.5) than female interns (median 3; median difference 2.0, 95% CI, 0.1–3.9; [Table 2](#); [Figure](#), Panel A), but no difference was detected between interns with intubation experience (median 4) and those without (median 3; median difference 1.0, 95% CI, –1.8 to 3.8; [Figure](#), Panel B). Retrospective precurriculum confidence did not correlate with performance on either the

**Table 1.** Participant Characteristics

	Standard Curriculum (N = 26)	Video Curriculum (N = 23)	Overall (N = 49)
Year of training			
Intern/PGY1	26 (100%)	23 (100%)	49 (100%)
Gender			
Male	8 (31%)	8 (35%)	16 (33%)
Female	18 (69%)	15 (65%)	33 (67%)
Prior successful intubations			
None	20 (77%)	18 (78%)	38 (78%)
$\geq 1$	6 (23%)	5 (22%)	11 (22%)

**Table 2.** Confidence Scores Pre- and Postcurriculum, Stratified by Gender and Prior Intubation Experience

	Confidence Scores	
	Precurriculum	Postcurriculum
Gender		
Male (n = 16)	4.5 [3, 6.5]	6 [5, 7]
Female (n = 33)	3 [1, 4]	7 [6, 8]
Prior Successful Intubations		
None (n = 38)	3 [2, 5]	6 [5, 8]
$\geq 1$ (n = 11)	4 [3, 5]	7 [6, 8]

Values in table represent median [interquartile range].

knowledge-based assessment (Spearman's  $\rho = 0.157$ ,  $P = .281$ ) or procedural assessment on the simulated scenarios (hazard ratio = 1.08; 95% CI, 0.99, 1.17).

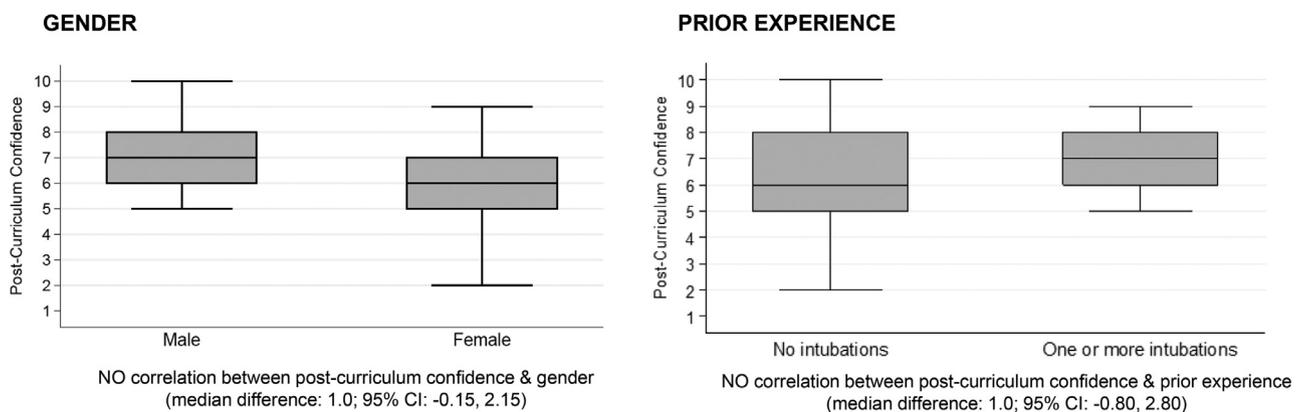
Self-reported confidence for the full sample after completing the curriculum increased to a median of 6 (interquartile range 5–8; median difference [95% CI] of pre- vs postcurriculum confidence: 3.0 [2.05, 3.95]). No differences in post-curriculum confidence were found in comparison of male (median 7) and female interns (median 6; median difference: 1.0; 95% CI, –0.15, 2.15) or between interns with intubation experience (median 7) and those without (median 6; median difference: 1.0; 95% CI, –0.80, 2.80). There was no correlation between performance on the knowledge-based assessment and postcurriculum self-reported confidence (Spearman's  $\rho = -0.03$ ,  $P$  value .85). There was also no correlation between TTSI on the airway trainers and postcurriculum self-reported confidence (hazard ratio 1.06, 95% CI, 0.97 –1.16).

In sensitivity analyses controlling for intervention type, the pattern of associations between of pre- and postconfidence and gender, experience, and performance did not change.

## DISCUSSION

In the clinical setting, supervisors who lack an opportunity to directly assess trainee competency often seek to assess procedural readiness by asking trainees about their confidence in their procedural skills and their prior experience, as well as by utilizing questions posed to assess their medical knowledge surrounding the procedure. We found that pediatric interns' self-reported confidence in endotracheal intubation does not correlate with prior experience, airway management knowledge or measured intubation performance on airway trainers; there were, however, significant differences in confidence associated with gender, with male pediatric interns reporting higher precurricular confidence compared to their female colleagues. Together, these findings suggest that self-reported confidence is not an accurate means of assessing procedural readiness.

Our finding that male pediatric residents report higher precurricular confidence with procedural skills than their female counterparts adds to the literature showing gender differences in confidence across all levels of medical providers. A survey-based study of graduating medical

**Panel A: Pre-curriculum Confidence****Panel B: Post-curriculum Confidence**

**Figure.** Panel A: Pre-curriculum confidence by gender and prior experience. Panel B: Post-curriculum confidence by gender and prior experience.

students shows that this gap can be seen early in medical training. Barr et al found that male students reported a higher level of confidence than their female counterparts across all levels of procedural experience.<sup>24</sup> Dehmer et al similarly found that male medical students are more confident in intravenous catheter placement and venipuncture than their female peers, and work by Lind et al showed that female students have lower self-assessments, despite outperforming their male peers, on surgical clerkships.<sup>10,25</sup> Assessments of those in practice have also shown that males demonstrate higher confidence compared to females in both clinical and research settings, even after controlling for experience.<sup>26,27</sup> Studies have focused specifically on confidence in procedural skills among pediatric trainees as well; however none appear to report findings based on gender.<sup>28–30</sup> Our results show that disparate levels of confidence in performing procedures across gender exists within pediatric graduate medical education as well. Supervisors should be aware of the possible influence of gender when using confidence as a proxy for competence and procedural readiness.

It is important to highlight that the gender difference in confidence applied only to the precurriculum confidence; immediately after the curriculum there was no statistically significant difference in confidence by gender, although

the median score for males remained higher. This implies that the curriculum itself may have had a differential effect on confidence among female and male participants, with females having a larger increase in confidence than their male counterparts. Work by Blanch et al has shown a similar leveling of gender differences in confidence among medical students over the course of an objective structured clinical exam, with male students starting out significantly more confident than female students but the difference decreased over the course of the objective structured clinical exam; similar to our findings, males remained more confident throughout but the difference was not statistically significant by the end of the activity.<sup>31</sup> Blanch and others have proposed that gender differences in confidence are due to both overestimation by males and underestimation by females.<sup>31,32</sup> We hypothesize that performing the activity of interest, in this case endotracheal intubation as part of the curriculum, may serve to help one or both genders more accurately self-assess and align their confidence and competence.

We did not find a statistically significant correlation between experience and confidence among those who participated in our curriculum. However, our curriculum included only interns with limited prior clinical airway exposure. Van Schaik et al examined the relationship

between pediatric resident confidence in resuscitation skills and their experience in both mock and real codes. They were able to demonstrate a correlation between prior experience and confidence in resuscitation skills, including advanced skills such as intubation.<sup>33</sup> Augustine et al also demonstrated a positive correlation between prior procedural experience and confidence.<sup>29</sup> The difference in findings may reflect increased prior procedural experience by participants in these curricula, which included pediatric junior and senior residents as well as interns. Similar to our findings, when Resch et al looked at the relationship between competence, confidence, and experience in pediatric interns in the closely related skill of bag mask ventilation, they found no correlation.<sup>11</sup> This matches what has been described in the psychology literature as the Dunning Kruger effect: novices with limited skill and experience are more at risk of assessing their ability as greater than it is.<sup>12</sup>

Finally, our findings add to the body of literature demonstrating that self-reported confidence does not correlate with competence.<sup>10,34</sup> In our study population, confidence did not correlate with demonstrated competence defined using objective performance metrics. One study of interns showed a lack of correlation between self-reported confidence and observed competence with regard to both knowledge and procedural skills.<sup>35</sup> Other studies of pediatric residents' performance of resuscitation skills and procedures also found confidence was incongruous with performance. Within these studies, the majority of residents reported comfort with included procedural skills, while only a minority performed the skills correctly when evaluated with direct observation.<sup>28,36,37</sup> Importantly, similar to Tofil et al, we used objective rather than subjective (self-reported) measures of performance when assessing correlation between confidence and competence.<sup>36</sup> This has important implications in terms of supervisors' tendency to use confidence as a proxy for competence or skill, which may result in an inaccurate assessment of procedural readiness. This may be particularly important in infrequently performed procedures such as endotracheal intubation, where supervisors lack opportunities to assess competence. Inflated belief in one's likelihood to succeed may improve task motivation and commitment,<sup>38</sup> however this may also result in trainees being willing to undertake tasks for which they are not adequately prepared and being less open to asking for help.<sup>6</sup> Importantly, low self-confidence can also have untoward effects, including an underestimation of task readiness leading to avoidance of activities that might well be within a provider's capabilities.<sup>38</sup>

#### LIMITATIONS

Our study must be interpreted in the context of its limitations. Its generalizability is limited in that it was a single center study of pediatric interns. Participants self-reported prior experience, raising the possibility of recall bias. Prior work has suggested that there may be gender differences in recall bias.<sup>39</sup> In addition, we did not collect

demographic information on other factors that could potentially impact confidence such as participant age or intended specialty. Furthermore, our precurriculum confidence was retrospectively reported. As such, the completion of the curriculum or performance on either the knowledge-based assessment or the airway trainers may have influenced participants' responses. As mentioned previously, we aimed to identify the most accurate pre- and postcurricular confidence estimations by using retrospective self-assessment, which has been shown to minimize changes in assessment standards over time and improve learners' self-reflection.<sup>20–22</sup> It is also important to note that we used the common term “self-confidence” concerning the task of intubation with participants. Much psychology literature instead uses constructs of task-specific self-efficacy to measure self-reported likelihood to succeed with a task attempt—a definition similar to the concept of self-confidence.<sup>40</sup> We opted to use language that we believed would be more familiar to participants and mirrored that terminology here in the presentation of our findings. Future research of this type could leverage the self-efficacy construct. Finally, we assessed performance in simulated scenarios rather than in the clinical setting. While we attempted to collect data on subsequent opportunities for intubation of patients, such opportunities were too rare.<sup>18</sup>

#### CONCLUSIONS

When asked to self-report confidence in endotracheal intubation, pediatric interns' responses do not correlate with prior experience, intubation performance on airway trainers, or airway management knowledge. However, male pediatric interns initially report higher confidence compared to their female colleagues prior to the curriculum—signaling a need for further exploration into gender influences on self-assessments, performance, and likelihood to request assistance. Further research into what influences trainees' self-reported confidence and performance is needed if it is used in-practice to guide decisions on procedural readiness. Our study also highlights the need to identify more accurate screens for procedural readiness.

#### SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.acap.2019.06.013>.

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