Research Square

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Non-technical skills of medical students in the course of pediatric emergency simulations are associated with their mindfulness: an observational cohort study

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Abstract

Background High fidelity medical simulations allow for teaching medical skills in safe and realistic conditions. Pediatric teams of emergency departments work under extreme stress, which affects high-level cognitive functions, specifically attention and memory, and increases the already high stakes for young doctors. Lapses in attention increase the risk of serious consequences such as medical errors, failure to recognize life-threatening signs and symptoms, and other essential patient safety issues. Mindfulness as a process of intentionally paying attention to each moment with curiosity, openness and acceptance of each experience without judgment can potentially contribute to improving the performance of medical teams in conditions of pediatric emergency. The aim of the study was to determine whether the actions of medical students in the course of pediatric high fidelity simulations are related to their mindfulness. Participants and methods A total of 166 standardized simulations were conducted among students of medicine in three simulation centers of medical universities, assessing: stress sensation, technical skills (checklists), non-technical skills (Ottawa Crisis Resource Management Global Rating Scale) and mindfulness using Five Facet Mindfulness Questionnaire. Results The perception of stress among students was lower and more motivating if they were more mindful. Mindfulness of students correlated positively with avoiding fixation error, but negatively with listening to and managing the team. The lowest scores among non-technical skills were noted in the area of situational awareness (fixation error). In subsequent simulations of the same team, students' non-technical skills improved, although no change was noted in their technical skills. Conclusions The results of our research indicate the relationship between the mindfulness of medical students and their non-technical skills and the perception of stress in pediatric emergency simulations. Further research is needed to show whether mindfulness training leads to any changes in this field. Trial registration ClinicalTrials.gov, NCT03761355).

Background

Medical simulation is a technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing or to gain understanding of systems or human actions [1]. It has been shown that emergency medicine simulation may create a high physiological fidelity environment similarly to what is observed in a real emergency room [2]. We can teach skills, clinical decision making, communication and teamwork in an environment that is safe for the patient and the student (“psychological reality and safety”) [3]. Simulation scenarios cover technical (e.g. diagnostic and therapeutic procedures) and non-technical skills. Non-technical competences are the skills of communication, leadership, teamwork, situational awareness, decision-making, resource management, safe practice, adverse event minimization, and professionalism, also known as behavioral or teamwork skills [1]. Life-threatening situations are less frequent in pediatric than in adult emergencies, and also requirements for non-technical and technical skills may be stronger in pediatrics and neonatology than in other fields of healthcare [4].

Pediatric emergency department staff work in intense, chaotic and unpredictable environments and have been shown to have the highest levels of psychosocial distress among all healthcare providers [5]. Stress affects high-level cognitive functions, specifically attention and memory, and this increases the already high stakes for young doctors. They are required to cope with very difficult situations that require accurate, timely decisions that affect children's lives on a daily basis. Lapses in attention increase the risk of serious consequences such as medical errors, failure to recognize life-threatening signs and symptoms, and other essential patient safety issues [6]. Therefore, the methods of stress reduction are being sought.

Mindfulness is a process of intentionally paying attention to each moment with curiosity, openness and acceptance of each experience without judgment [7]. This is achieved through an attitude of lack of valuation, clarity, acceptance, patience, sincerity, unexpectedness, loving kindness, care and compassion for the current situation. The goal of mindfulness is to empower individuals to respond to situations consciously rather than automatically. All these features can have a potentially positive effect on workplace functioning in healthcare. Being mindful is associated with decreased stress, anxiety, depression, improved mood, self-empathy and empathy among medical students [8]. So it is possible that mindfulness could enhance medical students' capacity for focused attention and concentration by increasing present moment awareness.

No research has been performed concerning the association between being mindful and performance in emergency medicine under standardized conditions. The aim of our work was to test the hypothesis that technical and/or non-technical skills of medical students during pediatric emergency simulations are related to their mindfulness. In general, we anticipated that the results of our study could lead to better understanding of the mechanisms that influence performance of medical students during pediatric emergency cases and may enable them to improve their skills in their future professional life.

Methods

Participants

The project was planned as an observational cohort study in a group of medical students (ClinicalTrials.gov ID: NCT03761355). The research was conducted between October 2017 and October 2018 in three Polish medical simulation centers. The inclusion criterion was being a student of medicine and consent to participate in the study. The exclusion criterion was pregnancy.

Medical simulations

The simulations were constructed as high-fidelity scenarios in life-threatening situations in children (topics: supraventricular tachycardia, febrile convulsions, bronchial asthma, ketoacidosis, anaphylactic shock, paracetamol intoxication). They started in the morning and were identical for all groups of students (the same introduction to the simulator and medical equipment based on checklists and the same order of the scenarios). The level of task difficulty was intermediate and was evaluated based on

the pilot simulations with both students and young doctors. Each scenario had two equal goals - technical and non-technical. During the implementation of the simulation scenario, the students played different roles (team manager, member of the medical team or actor - the patient's caregiver). The analysis concerns only the scenarios in which the students acted as team leaders (skills and interactions with the other participants of the simulation were assessed).

The following data of medical students were assessed: age, sex and the fact of participating in mindfulness training or other secular or religious meditations. Stress and its impact on simulation were assessed both subjectively by participants (in a five-step scale from mobilizing to discouraging; the higher the score, the greater or more discouraging the stress) as well as by assessing the heart rate and blood pressure. Medicines taken and the amount of caffeine consumed by students every day and before the simulation were also noted, as well as the subsequent number of the simulation on a given day and during the entire medical studies.

Technical and non-technical skills

Technical skills were assessed on the basis of checklists designed and validated for each scenario. The assessment was divided into an interview, physical examination, diagnosis and treatment. The more points on the scale, the better the technical skills.

Non-technical skills were assessed by the *Ottawa* Crisis Resource Management *Global Rating Scale* (*Ottawa GRS*) and checklist [9, 10]. The Ottawa GRS, an instrument developed for crisis resource management skill assessment, was designed for acute care physicians. It has well-defined rating scales for each of its categories: leadership skills (stays calm and in control during crisis, prompt and firm decision-making), situational awareness (avoids fixation error), communication skills (communicates clearly and concisely, uses directed verbal /non-verbal communication, listens to team input), problem solving (organized and efficient problem solving approach, considers alternatives during crisis), resource utilization (calls for help appropriately, utilizes resources at hand) [9]. Each category is measured on a seven-point anchored ordinal scale with descriptive anchors to provide guidelines on alternating points along the scale. These descriptions are added to reduce personal bias in interpreting performance. The higher the Ottawa GRS score, the better the non-technical skills.

Prior to the research protocol all instructors were trained in the assessment of non-technical skills by Grzegorz Cebula and Kamil Torres – international experts in this field. Non-technical skills were assessed by two independent instructors / observers during each simulation in each center. All the instructors had more than two years of work experience in the simulation center, performing and assessing at least 50 simulations of high-fidelity each year. They were all trained for the minimum of 3 years in simulation and debriefing. Mean scores between the two observers were used as the reference value.

Mindfulness

Mindfulness was assessed according to the short version of Five Facet Mindfulness Questionnaire (FFMQ) in Polish adaptation and validation [11, 12]. FFMQ is used to measure the depth of mindfulness, that is, the specific state of attention, which is the result of constantly directing attention, in the non-evaluative and non-judgmental way, to what is happening at the present moment. FFMQ evaluates five factors: conscious presence, non-reactivity, non-judgment, observation and description. The higher the FFMQ score, the higher the level of mindfulness.

The study design was approved by the Ethics Committee at the Medical University of Bialystok in accordance with the Declaration of Helsinki (No R-I-002/358/2017). Signed informed consent was obtained from students. The rates of consent was 94.9%. The main reason for the consent refusal was lack of time to complete the survey. Students who agreed to participate in the study and those who did not give their consent did not differ in sex, age or in technical and non-technical skills assessment scores.

Data are presented as means and standard deviation (SD) and rates of incidence of a given characteristic in the evaluated group of students. Univariate analysis was conducted using the *Mann–Whitney* U *test* for continuous variables and the Chi-square test for the nominal ones. Correlations were performed using Spearman's correlation. Multivariate adjusted linear regression was used to evaluate the impact of mindfulness and other assessed features on the results in technical and non-technical skills (including Ottawa GRS scale). A $p < 0.05$ was considered statistically significant. Statistical analysis was performed using the Statistica 13 software (StatSoft, Tulsa, OK, USA). Only students with all data available were included in the analysis.

Results

In total, 166 students were qualified for the study. As each student played a role of a team leader in a pediatric emergency situation at least once, 166 simulations were analyzed. Data referring to age, sex, meditation / prayer, use of caffeine and medicines, and stress before and after simulations are shown in Table 1. The average results of students on the scales of technical and non-technical skills and mindfulness are presented in Table 2.

Stress is associated with students' mindful presence

The students' perception of stress before and during simulation correlated with their mindfulness. The lower perception level of stress before simulation was related to lower reactivity, lower level of judgment and higher level of description of the present moment (respectively: $r = -0.36$, $p < 0.001$, $r = -0.24$, $p = 0.01$, $r = -0.29$ $p < 0.001$). In addition, stress appearing during simulation was perceived as more mobilizing if the students were characterized by lower reactivity and higher level of description of the present moment (respectively: $r = -0.19$, $p = 0.01$, $r = -0.23$, $p = 0.004$).

Participation in meditations / prayers did not affect the other parameters assessed in the study. No correlation was also observed in the use of caffeine permanently and before simulation in relation to pre-simulation stress, the heart rate and blood pressure before and after simulation. No differences were

found between meditating and non-meditating students in the mindfulness scale (non-reactivity, observation, conscious action, describing and not judging).

Non-technical skills of medical students improve in subsequent simulations

The stress experienced before a simulation influenced some of the parameters on the non-technical skills scale (the Ottawa GRS). There was a positive correlation between the subjective feeling of stress before the simulation and the obtained results in terms of global perspective, team management and communication in the team (all $r = 0.22$, $p = 0.01$); the perceived stress was not related to technical skills assessed by a dedicated, standardized checklist.

The total outcome of students in technical skills was not correlated with the total score obtained in non-technical skills. However, a better ability to regularly re-evaluate the patient's condition and situation (the Ottawa GRS) was associated with a higher score in technical skills ($r = 0.27$, $p = 0.01$).

The analysis of all completed simulations showed that all non-technical skills improved along with the number of high-fidelity medical simulations performed by a given team ($r = 0.33$, $p < 0.001$). This correlation was not observed in the case of technical skills ($p > 0.05$).

A comparison of the Ottawa GRS scores showed statistically significantly lower average scores for situational awareness skills (fixation error) than for other non-technical skills of medical students ($p < 0.001$) - Table 2. Situational awareness skills did not correlate with stress, using caffeine, medications or participating in meditations / prayers.

The soft skills of students are related to their mindfulness

The results of the students obtained in checklists in the area of technical skills did not correlate with their mindfulness ($p > 0.05$). Similarly, the FFMQ scale total score was not related to the total score obtained using the Ottawa GRS for non-technical skills. However, some non-technical skills during simulations were associated with certain mindfulness traits of medical students. Avoiding fixation error (situational awareness skills) was positively associated with conscious action on the mindfulness scale ($r = 0.29$, $p < 0.01$,). Firm action and maintaining control over the team correlated negatively with non-reactivity ($r = -0.25$, $p < 0.01$). However, the ability to manage the team was negatively correlated with careful description according to the FFMQ scale ($r = -0.25$, $p < 0.01$). Similarly, the results of attentive listening to the team were poorer in less judgmental students ($r = -0.29$, $p < 0.01$).

Mindfulness of students did not correlate with a change in the level of perceived stress, or alterations in heart rate and pressure before and after a simulation.

The regression analysis showed that the variability in the ability to avoid fixation error was partially explained by one of the awareness traits, i.e. conscious action ($R = 0.29$, $R2 = 0.06$, $p = 0.01$). Similarly, non-reactivity and careful description explained firm action and maintaining control over the team ($R =$

-0.25, R2 = 0.04, p = 0.01), and judging gave reason for variability in listening to the team skills (R = -0.29, R ^ 2 = 0.06, p = 0.001).

Discussion

In standardized conditions of pediatric high-fidelity simulations, we searched for links of conscious presence with technical and non-technical skills as well as the perception of stress by medical students. The stress was milder and more motivating if the students were more mindful. Mindfulness of students correlated positively with avoiding fixation error, but negatively with listening to and managing the team. The results of our research indicate the importance of mindfulness in teamwork during simulated pediatric emergency cases. So far, no such research has been carried out, and the effect of mindfulness on physicians' performance in emergency medicine, whether beneficial or not, was only hypothetical.

Interesting are the evolutions of stress perception as well as technical and non-technical skills in subsequent simulations performed in the same team of students or doctors. In our study, the technical skills of students did not change in subsequent simulations, contrastingly with the non-technical skills that improved while gaining experience in team activities. The technical skills of doctors from emergency departments, assessed with the use of critical action checklists were found to improve significantly following implementation of a scenario of diabetic ketoacidosis in children [13], which was similar to our scenario. Interestingly, community emergency departments with medium pediatric volume showed the most overall improvement, and teams from departments that are further from academic centers showed the least improvement from baseline. However, a simulation performed e.g. as a two-day training, resulted in a reduction in stress perception among residents of the first year of emergency medicine, but not among pediatricians treating children with life-threatening conditions [5]. It is difficult to explain the reasons for this phenomenon, perhaps it is related to the simulation itself. In our opinion, the results in terms of technical skills and stress perceived by students are most affected by variables that are difficult to assess: subjective difficulty of the scenario for a given team manager, clarification of information concerning simulations for students before classes, time to prepare for classes, accompanying credits and exams etc. Besides, our classes were held in the last year of medical education, when some students already have definite plans for further specialization. Thus, for instance, we can often observe that those associating their future career with cardiology are better at executing a cardiology-related scenario, perhaps due to better knowledge in this field and higher motivation.

In our group of medical students the total score on the technical skills scale did not correlate with the overall result of the non-technical competencies. However, one of the soft skills components, i.e. greater capacity to regularly reassess patient's condition and situation, resulted in a higher score on the technical skills scale. In similar conditions of pediatric simulations no direct relationship was found between situation awareness and goal achievement [14]. In that study, consensus on the primary problem (shared mental model) led to faster achievement of predefined goals. However, in other acute care simulations, non-technical skills significantly predicted students' clinical performance as assessed by nurses [15]. In one of the studies, like in our group, repeating the simulation improved non-technical skills, such as

communication, teamwork, situational awareness and decision making [16]. However, Clarke et al. showed that the only variable affecting the overall assessment of non-technical competencies during simulations (also evaluated by the Ottawa GRS) was the residents' progress in the specialization program (so-called PGY status) or clinical experience rather than stress or its subjective feeling [17].

Our goal as educators is not only to train to acquire a given skill, but above all to maintain it in the future work with a patient. In scenarios referring to the field of pediatric allergic diseases, simulations turned out to be effective in the acquisition of non-technical skills by allergists [18]. Most importantly, these skills were also maintained 10-12 months after training completion. Either way, there is a huge need to teach non-technical competencies to students and young doctors, and simulation is certainly the right technique to teach them [19].

It is extremely difficult to perform research that can show the impact of mindfulness on patient care. We were the first to show that mindfulness is associated with non-technical skills in pediatric emergency simulations. However, this influence varied - greater mindfulness correlated with avoiding fixation error, but also with less decisive action and team management. In our opinion, situation awareness (fixation error) was the weakest non-technical skill among all the skills assessed using the Ottawa GRS scale. During the pre-briefing, students often uttered a probable diagnosis aloud and were fixating on it during the simulation, without verifying the hypothesis, despite all data received (interview, physical examination, additional test results). Loss of situation awareness can lead to errors. It sometimes happens that a team member notices something, is able to make a correct diagnosis or suggest proper treatment, but does not speak up. The reasons for this include not wanting to be wrong, not wanting to hurt someone's feelings, or not being sure [20]. There are tools to improve situational awareness. For instance, the Simulation-Based Crisis Resource Management training implemented among pediatric cardiac intensive care unit providers has improved reporting of doubts concerning the appropriate procedure to the team leader [21].

The FFMQ scores obtained by our medical students were similar to the results reported from the group of 800 Polish adults among whom the scale was validated, thus indicating that medical students are as mindful as other adult Poles [11]. In our project, we failed to find a relationship between trait mindfulness and heart rate or blood pressure and changes in them after simulation. Recently, it has been pointed out that trait mindfulness is significantly correlated with self-similarity of cross-talking heart rate variability (HRV) parameter but not with the HRV parameters at the difference-change or absolute levels [22]. However, meta-analyses show that mindfulness training significantly reduces cardiac activity and blood pressure in the population [23]. In our observation, a higher level of mindfulness not only reduced the subjective perception of stress before simulation, but also correlated with its more motivating impact during the simulation scenario. The results of some studies indicate a connection between mindfulness and well-being or education and work in medical professions and in students of medical courses. Such mindfulness effects as reduced stress, increased self-regulation (the ability to effectively manage one's thoughts and actions to complete a task) can be particularly useful for medical students during pediatric emergency cases. A meta-analysis of 19 studies concerning the use of mindfulness in medical students showed that mindfulness-based interventions decrease stress, anxiety, depression and improve

mindfulness, mood, self-empathy and empathy [8]. As revealed by the authors of that analysis, mindfulness training can be relatively easily adapted and integrated with modern teaching of medicine.

Certainly mindfulness is a major strategy to enhance wellness in emergency medicine residency training programs [24]. Students who chose emergency medicine as their future specialization and participated in a mindfulness course during summer holiday clerkships noted changes in self-reported behaviors and attitudes that lasted for up to 6 months after intervention [25]. Despite the small size of the group sample (20 students), this may indicate that burnout syndrome can be prevented in future emergency medicine physicians. A focus on the present moment can help young doctors concentrate on what is really important, which may refer both to helping patients and themselves. Similarly, mindfulness traits were associated with reduced anxiety, depression and burnout in emergency room nurses [26]. Mindfulness objective is to allow healthcare workers to keep a distance from a mentally and emotionally stressful environment. Mindfulness can also be helpful in teaching professionalism, including accepting one's own boundaries, priorities and being resilient. In one study, more mindful residents asked for help more often and seemed to be more open toward feedback [27]. In our simulations, one of the technical skills, in some scenarios, was to call a specialist for consultation. However, we found no connection between greater mindfulness and more frequent requests for help in this area (data not presented). Learning critical thinking, developing cognitive and affective biases, using such processes as reflection and mindfulness can lead to greater creativity, lateral thinking, and innovation in the diagnosis and treatment of patients [28]. Perhaps the routine diagnostic and therapeutic process that does not always produce a desired effect should be enriched with the awareness of the inhibitors and facilitators of rationality in decision making. It seems that the simulation room is a very good place to learn mindfulness in diagnostic and therapeutic procedures before applying this technique in real medical life. Park and Holtschneider suggest 6 steps of mindfulness in this field: pause, breathe, identify the emotion, recognize the space between stimulus and response, choose how to respond and respond [29].

The strength of our study is the unique pediatric character of the simulation, a large number of participants and simulations, great experience of simulation centers involved in the project, lack of voluntary nature of the research and standardized conditions for study implementation. The limitations of our study are certainly the subjectivity and difficulty of the Ottawa GRS application for the non-technical skills. However, this tool is considered to be easier to use, more practical and more reliable than a similar instrument i.e. Anesthetists' Non-Technical Skills (ANTS) behavioral marker system [10]. Our project also lacks self-assessment of students’ activities, and it would be extremely interesting to compare it with the assessment of instructors. However, our attempts to carry out such assessments failed: students were not able to evaluate their actions using quite complicated scales. Moreover, the outcome of our research conducted with medical students cannot fully translate into the real work of physicians, since the final effect involves a great deal of additional factors as well as professional environment or family, etc., which determine the attainment of mindfulness objectives in everyday work with patients in hospital or outpatient clinic.

Does greater mindfulness indeed influence the actions of doctors in real medical situations? Should mindfulness be included in the university curriculum for medical students ? Should mindfulness be taught as an elective or obligatory subject ? It would be interesting to check when the interventions are optimal – at the beginning or end of the study, at the start or finish of the residency period? These and many other questions should be answered in future randomized trials.

Conclusions

The results of our research indicate a relationship between mindfulness of medical students and their non-technical skills and the perception of stress in simulations of pediatric emergency situations. Further research is needed to show whether mindfulness training leads to changes in this field. Perhaps mindfulness courses should be included in the medical university curriculum and early career of a young doctor to reduce stress and improve the diagnostic and therapeutic effectiveness of physicians working individually and in teams.

Abbreviations

ANTS - Anesthetists' Non-Technical Skills

FFQM - Five Facet Mindfulness Questionnaire

HRV - heart rate variability

Ottawa GRS - Ottawa Crisis Resource Management *Global Rating Scale*

Declarations

- Ethics approval and consent to participate

The study design was approved by the Ethics Committee at the Medical University of Bialystok in accordance with the Declaration of Helsinki (R-I-002/358/2017). Signed informed consent was obtained from all participants.

- Consent for publication

Not applicable

- Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

- Competing interests

The authors declare that they have no competing interests.

- Funding

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- Authors' contributions

JC, WŁ, GC, TB and KT designed the study; JC and WŁ were a major contributors in writing the manuscript; WŁ, JD, TB and KT collected and analysed the patient's data; all authors read and approved the final manuscript.

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References

1. Lopreiato JO, Downing D, Gammon W, Lioce L, Sittner B, Slot V, et al. Healthcare Simulation Dictionary. Retrieved from http://www.ssih.org/dictionary.2016.
2. Daglius Dias R, Scalabrini Neto A. Stress levels during emergency care: A comparison between reality and simulated scenarios. J Crit Care. 2016;33:8-13.
3. Bragard I, Farhat N, Seghaye MC, Schumacher K. High fidelity simulation : a new tool for learning and research in pediatrics. Rev Med Liege. 2016;71(10):455-9.
4. Cavicchiolo ME, Cavallin F, Staffler A, Pizzol D, Matediana E, Wingi OM, et al. Decision making and situational awareness in neonatal resuscitation in low resource settings. Resuscitation. 2019;134:41-8.
5. Bragard I, Seghaye MC, Farhat N, Solowianiuk M, Saliba M, Etienne AM, et al. Implementation of a 2-Day Simulation-Based Course to Prepare Medical Graduates on Their First Year of Residency. Pediatr Emerg Care. 2018;34(12):857-61.
6. Botha E, Gwin T, Purpora C. The effectiveness of mindfulness based programs in reducing stress experienced by nurses in adult hospital settings: a systematic review of quantitative evidence protocol. JBI Database System Rev Implement Rep. 2015;13(10):21-9.
7. Kabat-Zin J. Mindfulness-Based Interventions in Context: Past, Present, and Future. Clinical Psychology: Science and Practice. 2003;10(2):144-56.

8. McConville J, McAleer R, Hahne A. Mindfulness Training for Health Profession Students-The Effect of Mindfulness Training on Psychological Well-Being, Learning and Clinical Performance of Health Professional Students: A Systematic Review of Randomized and Non-randomized Controlled Trials. Explore (NY). 2017;13(1):26-45.
9. Kim J, Neilipovitz D, Cardinal P, Chiu M. A comparison of global rating scale and checklist scores in the validation of an evaluation tool to assess performance in the resuscitation of critically ill patients during simulated emergencies. Sim Healthcare. 2009;4:6-16.
10. Jirativanont T, Raksamani K, Aroonpruksakul N, Apidechakul P, Suraseranivongse S. Validity evidence of non-technical skills assessment instruments in simulated anaesthesia crisis management. Anaesth Intensive Care. 2017;45(4):469-75.
11. Radon S. Validation of the Polish adaptation of the Five Facet Mindfulness Questionnaire. Annals of Psychology. 2014;17(4):737-60.
12. Bohlmeijer E, ten Klooster PM, Fledderus M, Veehof M, Baer R. Psychometric properties of the five facet mindfulness questionnaire in depressed adults and development of a short form. Assessment. 2011;18(3):308-20.
13. Abulebda K, Whitfill T, Montgomery EE, Kirby ML, Ahmed RA, Cooper DD, et al. Improving Pediatric Diabetic Ketoacidosis Management in Community Emergency Departments Using a Simulation-Based Collaborative Improvement Program. Pediatr Emerg Care. 2019;in press.
14. Coolen E, Draaisma J, Loeffen J. Measuring situation awareness and team effectiveness in pediatric acute care by using the situation global assessment technique. Eur J Pediatr. 2019;in press.
15. Cha JS, Anton NE, Mizota T, Hennings JM, Rendina MA, Stanton-Maxey K, et al. Use of non-technical skills can predict medical student performance in acute care simulated scenarios. Am J Surg. 2019;217(2):323-8.
16. Marker S, Mohr M, Østergaard D. Simulation-based training of junior doctors in handling critically ill patients facilitates the transition to clinical practice: an interview study. BMC Med Educ. 2019;19(1):11.
17. Clarke S, Horeczko T, Cotton D, Bair A. Heart rate, anxiety and performance of residents during a simulated critical clinical encounter: a pilot study. BMC Med Educ. 2014;14:153.
18. Kennedy JL, Jones SM, Porter N, White ML, Gephardt G, Hill T, et al. High-fidelity hybrid simulation of allergic emergencies demonstrates improved preparedness for office emergencies in pediatric allergy clinics. J Allergy Clin Immunol Pract. 2013;1(6):608-17.
19. Lee Chang A, Dym AA, Venegas-Borsellino C, Bangar M, Kazzi M, Lisenenkov D, et al. Comparison between Simulation-based Training and Lecture-based Education in Teaching Situation Awareness. A Randomized Controlled Study. Ann Am Thorac Soc. 2017;14(4):529-35.
20. Clapper TC, Lee J, Phillips J, Rajwani K, Naik K, Ching K. Gibson's theory of affordances and situational awareness occurring in urban departments of pediatrics, medicine, and emergency medicine. Educ Health (Abingdon). 2018;31(2):87-94.

21. Allan CK, Thiagarajan RR, Beke D, Imprescia A, Kappus LJ, Garden A, et al. Simulation-based training delivered directly to the pediatric cardiac intensive care unit engenders preparedness, comfort, and decreased anxiety among multidisciplinary resuscitation teams. J Thorac Cardiovasc Surg. 2010;140(3):646-52.
22. Sun S, Hu C, Pan J, Liu C, Huang M. Trait Mindfulness Is Associated With the Self-Similarity of Heart Rate Variability. Front Psychol. 2019;28(10):314.
23. Pascoe MC, Thompson DR, Jenkins ZM, Ski CF. Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. J Psychiatr Res. 2017;95(156-178).
24. Ross S, Liu EL, Rose C, Chou A, Battaglioli N. Strategies to Enhance Wellness in Emergency Medicine Residency Training Programs. Ann Emerg Med. 2017;70(6):891-7.
25. Chung AS, Felber R, Han E, Mathew T, Rebillot K, Likourezos A. A Targeted Mindfulness Curriculum for Medical Students During Their Emergency Medicine Clerkship Experience. West J Emerg Med. 2018;19(4):762-6.
26. Westphal M, Bingisser MB, Feng T, Wall M, Blakley E, Bingisser R, et al. Protective benefits of mindfulness in emergency room personnel. J Affect Disord. 2015;175:79-85.
27. Verweij H, van Ravesteijn H, van Hooff MLM, Lagro-Janssen ALM, Speckens AEM. Does Mindfulness Training Enhance the Professional Development of Residents? A Qualitative Study. Acad Med. 2018;93(9):1335-40.
28. Croskerry P. Adaptive expertise in medical decision making. Med Teach. 2018;40(8):803-8.
29. Park CW, Holtschneider ME. A case for mindfulness. Simulation-based six strategy framework. J Nurses Prof Dev. 2018;34(3):164-5.

Tables

Table 1. Data of medical students participating in pediatric simulations

Number of participants	166
Number of simulations	166
Mean age ±SD	24.5 ±1.2
Sex	M – 50 (30.1%) F – 116 (69.9%)
Participation in meditation courses / prayers	regular - 33 (19.8%) irregular - 39 (23.4%)
The usual use of caffeine (cups/day)	<1 – 60 (36.1%) 1÷≤2 - 82 (49.4%) ≥3 24 (14.5%)
The use of caffeine during the last 12 hours before simulation (cups)	<1 – 122 (73.5% 1÷≤2 - 42 (25.3%) ≥3 - 2 (1.2%)
The use of medicine that influenced the heart rate	6 (3.6%)
Mean subjective perception of stress before and after simulation (1 – no stress, 5 – very stressed)	2.2 ±0.8 vs. 2.4 ±0.9 (p>0.05)
Heart rate before and after the scenario	76.9 ±10.6 vs. 77.3 ±15.9 (p>0.05)
Blood pressure before and after the scenario (systolic / diastolic, mmHg)	119.9 ±11.2 / 78±5.9 vs. 124.0 ±13.4 / 84.2 ±5.2 (p>0.05)
Subjective assessment of the influence of stress on the performance during simulation (1 – mobilizing, 5 – discouraging)	2.34 ±0.73

Table 2. Results concerning technical, non-technical skills and mindfulness in medical students during pediatric emergency simulations

Technical skills* (mean ±SD)	Total	8.0 ±1.3
Non-technical skills (mean ±SD)**	Total	29.4 ±5.7
	Overall performance	4.7 ±1.1
	Leadership skills	4.9 ±0.9
	Problem solving skills	5.2 ±1.0
	Situational awareness skills	4.0 ±0.9***
	Resourses utilization skills	5.1 ±1.1
	Communication skills	5.2 ±1.1
Mindfulness (mean ±SD)	Total	3.2 ±0.4
	Nonreact	2.8 ±0.7
	Observe	3.4 ±0.8
	Actaware	3.2 ±0.4
	Describe	3.6 ±0.6
	Nonjudge	3.2 ±0.7

*max 10 points, **max 42 points,

***mean results for all students statistically significantly lower than in other non-technical skills ($p<0.001$)