ORIGINAL REPORTS

Enhanced Stress Resilience Training for UK Surgical Trainees; Effect and Evolution Evaluated

Oliver W. Luton[*], *Osian P. James*[*,†], *Katie Mellor*[*], *Catherine Eley*[*], *Luke Hopkins*[*], *David B.T. Robinson*[*], *Emma Barlow*[*], *Carter C. Lebares*[‡], *Wyn G. Lewis*[*,§,1] *and, Richard J. Egan*[¶,‖,1], *On behalf of the Welsh Surgical Research Initiative (WSRI) Collaborative*[2]

[*]Department of General Surgery, NHS Wales Health Education and Improvement Wales' School of Surgery, Tŷ Dysgu, Cefn Coed, Nantgarw, United Kingdom; [†]Department of General Surgery, Cardiff University School of Medicine, Heath Park, Cardiff; [‡]Department of General Surgery, University of California, San Francisco, California; [§]Department of General Surgery, University Hospital of Wales, Heath Park, Cardiff; [¶]Department of General Surgery, Morriston Hospital, Swansea Bay University Health Board, Swansea, United Kingdom; and [‖]Department of General Surgery, Swansea University, Singleton Park, Swansea, United Kingdom

INTRODUCTION: Core Surgical Training (CST) programs are associated with high burnout. This study aimed to assess the influence of Enhanced Stress Resilience Training (ESRT) over a 2-year period in a single UK Statutory Education Body.

METHOD: CSTs participated in 5-weeks of formal ESRT to address work stressors. The primary outcome measure was career progression related to curriculum metrics and National Training Number (NTN) appointment. Secondary measures related to burnout using validated psychological inventories.

RESULTS: Of 42 CSTs, 13 engaged fully with ESRT (31.0%; male 8, female 5, median age 28 year.), 11 engaged partially, and 18 did not. ESRT engagement was associated with better NTN appointment (ESRT 8/13 (61.5%) vs. not 1/18 (5.6%), $p = 0.025$), less burnout [aMBI; mean 5.14 (SD ± 2.35) vs. 3.14 (±2.25), F 6.637, $p = 0.002$, $\eta_p^2 = 0.167$], less stress [PSS-10; 19.22 (±5.91) vs. 15.79 (±5.47), F 8.740, $p < 0.001$, $\eta_p^2 = 0.200$], but more mindfulness [CAMS-R; 19.22 (±5.91) vs. 20.57 (±2.93), F 3.201, $p = 0.047$, $\eta_p^2 = 0.084$]. On multivariable analysis, Improving Surgical Training (run-through CST) program (OR 5.2 (95% CI 1.42-28.41, $p = 0.022$), MRCS pass (OR 17.128 (95% CI 1.48-197.11, $p = 0.023$) and ESRT engagement (OR 13.249, 95% CI 2.08-84.58, $p = 0.006$) were independently associated with NTN success.

DISCUSSION: ESRT was associated with less stress and burnout, better mindfulness, and most importantly 13-fold better career progression. (J Surg Ed 000:1−8. © 2023 The Authors. Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/))

KEY WORDS: burnout, occupational stress, mindfulness, curriculum, outcome assessment, surgical training

COMPETENCIES: Practice-Based Learning and Improvement

INTRODUCTION

Delivering an effective healthcare service carries a price. The relentless 24/7 pace of life carries pressure to complete scheduled tasks and hit arbitrary targets within often tight timeframes. Surgery, as a vocation, is inherently subject to the vicissitudes of game theory, with many unquantifiable attributes including communication, trust, and

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[1] Joint Senior Authors.

[2] Collaborators: M Abukhder, R Allen, O Allon, A Beveridge, A Burgan, S Canbilen, S Choi, H Collins, P Cripps, E Daketsey, I De Gruttola, J Faiz, C Foo, E Hadjikyriacou, K Harborough, J Hayes, C Holden, S Latif, H Li, A Lukaszewicz, I Mahamud, N Mallya, R Mann, S Maryosh, G Michael, R Mistry, M Yaseen, R Morris, A Naisbitt, K Ngai, K Oo, S Rajendran, M Ramsden, N Rokan, E Sams, N Shivakumar, A Siddiqui, W Thompson, J Topping, D Warrell, H Whewell, L Williams, S Yew, A Zander

Correspondence: Inquiries to Osian P. James, Cardiff University School of Medicine, Heath Park, Allensbank road, Cardiff, CF14 4XW; e-mail: Jamesop1@cardiff.ac.uk

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compassion. Often crude morbidity and mortality rates are the only measures of a doctors' performance[1] reinforcing the delusion that all complexity at work can be rationalized and problems resolved by numerical analysis.[2]

Stress is a physical, mental, or emotional factor that causes bodily or mental tension. Stressors can be external (environmental or social) or internal (psychological or physiological). Stress at work is common and not unique to one industry, and a key unanswered question is how stress can be measured and assimilated into reliable and important metrics?[1] Validated self-report outcomes and advanced methods for recording biometric stress are now more widely available (the latter in the form of wearable technology), yet however stress is recognized, evidence supporting effective intervention is limited.

Enhanced Stress Resilience Training (ESRT) is a secular mindfulness-based intervention adapted iteratively from Mindfulness Based Stress Reduction (MBSR), and tailored to the culture and context of surgery. ESRT aims to increase overall stress resilience and has been reported to show promise in improving subjective and objective measures of stress in surgical trainees. Lebares et al., in 2 single-institution randomized trials,[3,4] reported that ESRT feasibility and acceptability was associated with significant benefits in multiple discrete measures (executive function, burnout, pro-inflammatory markers of stress). Moreover, neural substrates implicated in problem-solving and mental imagery changed, as well as subjective positive perceptions regarding participants' sense of effective coping and stress mastery. These latter findings suggest benefits not adequately captured by contemporary study metrics.

The primary aim of this study was to assess the impact of ESRT on Core/ Improving Surgical Trainees (CST/ ISTs, akin to postgraduate year 3 to 4 surgical residents in North America) with regard to the composite metric of formal Joint Committee on Surgical Training (JCST) training progression outcome. These outcomes include Logbook numbers, Membership of the Royal College of Surgeons (MRCS) examination pass rates, Annual Review of Clinical Progression Outcomes (ARCPO), and appointment to a National Training Number (NTN). Secondary outcomes included review of potential ESRT psychological benefits regarding degree of burnout, stress, mindfulness, depression and anxiety measured with validated psychological inventories.

METHODS

A voluntary, nonrandomized sample of newly-appointed CSTs attending a Core Surgical Boot Camp[5] in September 2020 were approached for inclusion in the ESRT module vs. the standard prescribed CST curriculum.

The participation cohort was divided into 2 groups alphabetically to facilitate assignment to ESRT tutors. Data were collected using pre-/postintervention questionnaires comprising multiple psychological assessment inventories at base line (T1: preintervention) repeated at 8 weeks following completion of ESRT (T2: postintervention) and at 18 months follow-up (T3: follow-up).

At the end of each training year trainees undergo a standardized appraisal process by which they are held accountable to the training standards set by the JCST and GMC. This process is referred to as the Annual Review of Competency Progression (ARCP). Training metric outcomes reviewed at the trainees ARCP were then recorded and compared between ESRT intervention vs. nonintervention groups.

The ESRT course structure and delivery with qualitative data has been reported previously as a feasibility study.[6] Briefly, ESRT comprises 5 weekly consecutive 1-hour classes delivered by a qualified ESRT instructor. The study protocol is available in the Appendix. All aspects of the intervention and assessment were approved by the Health Research Authority (IRAS ID 278852) and written informed consent was obtained prior to participation.

Outcome Measures

The primary hypothesis was that ESRT participation increases IST/CST progression with regards to JCST metrics (Logbook numbers, Membership of the Royal College of Surgeons (MRCS) examination pass rates, Annual Review of Clinical Progression Outcomes (ARCPO), and appointment to National Training Number (NTN)) - a run-through training program equivalent to US Residency) and can form part of a prescribed curriculum. ARCP Outcomes and definitions have been previously published for review.[7]

A secondary hypothesis was that cognitive skills developed by ESRT will result in lasting beneficial effects apparent in multiple domains, assessed using validated questionnaires, including burnout (aMBI),[8] stress (PSS-10),[9] psychosocial well-being 9PHQ-2,[10] CAMS-R,[11,12] and anxiety STAI-6[13]). These assessment tools have been validated against an age-matched population of US Surgical residents.[14]

Analysis

Statistical analysis appropriate for nonparametric data were performed using SPSS version 27 (SPSS, IBM Corp, Armonk, NK, Chicago, IL). Repeated measures ANOVA were used to compare prevalidated psychological assessments at 3-time intervals (T1-3). Uni- and Multivariate analysis (MVA) using binary logistic regression with a backwards conditional model, was conducted to find independent associations with regards to NTN selection. The number of

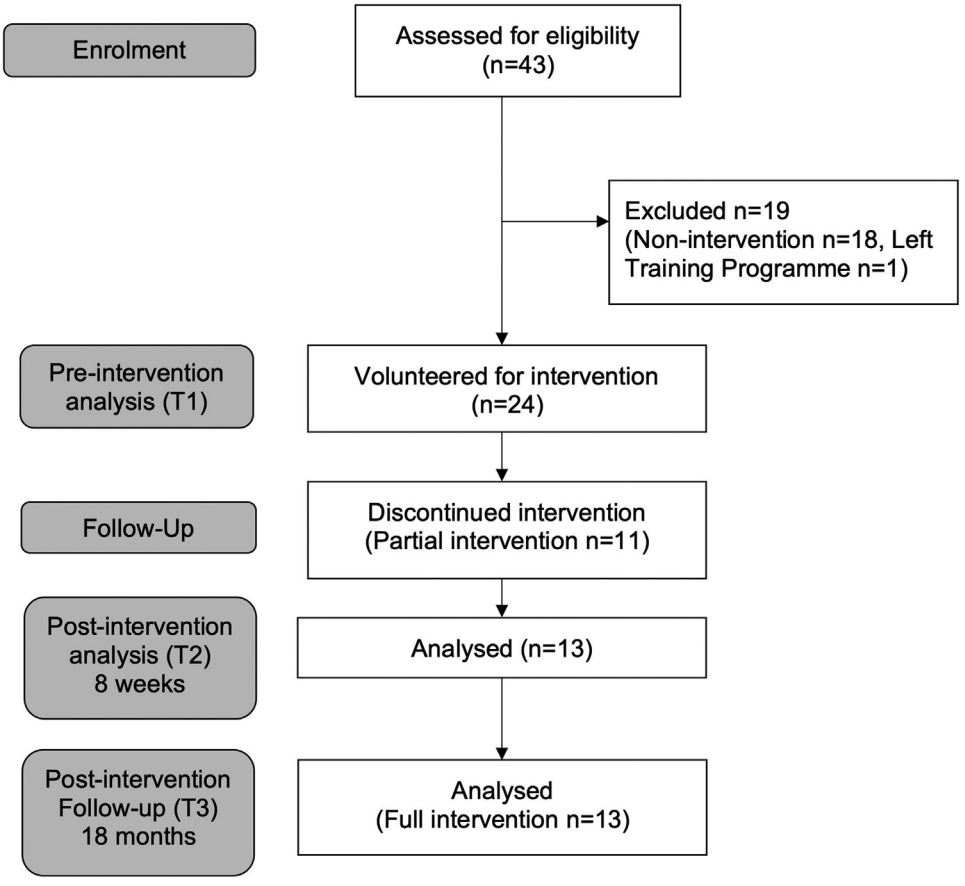

FIGURE 1. ESRT participation flow diagram.

outcome predictor variables incorporated into the MVA were representative of the event rate studied.

RESULTS

Of 43 CST boot camp attendees 24 volunteered to participate in the ESRT program. Of the 24 who committed to ESRT, 13 engaged fully and completed the intervention, 10 did not and one trainee was lost to follow-up (left the training program) at 2-years (Fig. 1).

The demographic details of the trainee participants in Intervention, Noncompletion and nonintervention groups can be found in Table 1.

At the completion of IST/CST year 2 there was no statistically significant difference in number of Logbook cases recorded, scientific publications or MRCS pass rate (Table 2). Full participation in ESRT was found to be significant with regards to NTN success.

A repeated measures Analysis of Variance (ANOVA) regarding the effect of ESRT shows its potential for decreasing burnout [aMBI; mean 5.14 (SD ± 2.35) vs. 3.14 (±2.25), F 6.637, p = 0.002, $\eta_p^2 = 0.167$] and stress [PSS-10; 19.22 (±5.91) vs. 15.79 (±5.47), F 8.740, p < 0.001, $\eta_p^2 = 0.200$], but increasing mindfulness [CAMS-R; 19.22 (±5.91) vs. 20.57 (±2.93), F 3.201, p = 0.047, $\eta_p^2 = 0.084$]. Full analysis of trainee psychological wellbeing related to the whole trainee cohort can be found in Table 3.

Uni- and Multi-Variable Analyses

Of 12 NTN appointments 6 were for general surgery trainees, four trauma and orthopedics, one otolaryngology, and 1 plastic surgery. Uni- and Multi-variable analyses (Table 4) revealed that full ESRT engagement was independently associated with Higher Surgical Training NTN appointment: 8/12 (66.7%) vs. control 5/30 (16.7%), OR 13.249, 95% CI 2.08 - 84.58, p = 0.006. The IST training program also appears to increase appointment to NTN 6/10 (60.0%) vs. control 6/26 (23.1%), OR 5.2 (1.42-28.41), p = 0.022.

TABLE 1. Core Surgical Trainee cohort demographic details

ESRT Participation*	Intervention (n = 13)	Noncompletion (n = 11)	Nonintervention (n = 18)
Male	8	3	10
Female	5	8	7
Age (years)	28 (25-32)	29 (26-34)	29 (26-35)
White UKG	9	4	8
BME UKG	2	3	5
IMG	2	4	5
CST	10	8	14
IST	3	3	4
General surgery	5	3	6
Trauma and orthopedics	4	4	3
Otolaryngology	2	1	3
Plastic	1	1	3
Urology	1	1	2
Neurosurgery	0	1	0
Cardiothoracic	0	0	1

Table 1 Demographics, medical degree, ethnicity, training program and surgical subspecialty of intervention, non-completion and non-intervention groups.
BME, Black or Minority Ethnic; UKG, United Kingdom Graduate; IMG, International Medical Graduate; CST, Core Surgical Training Program; IST, Improving Surgical Training Program.
*Intervention: >80% attendance of sessions; Noncompletion: 0%-80% attendance of sessions. Non-intervention: non-involvement).

DISCUSSION

The principal findings of this study are 4-fold: first, ESRT engagement was associated with less stress - PSS-10 scores were 18.0% lower in the intervention cohort than control; second, this translated into diminished burnout as defined by aMBI index scores - 38.9% lower in the intervention cohort than control; third, ESRT was associated with better mindfulness with CAMS-R scores 7% higher in the intervention cohort than control; fourth, full ESRT engagement was associated with a 13-fold better career progression as defined by UK Higher Surgical National Training Number promotion.

ESRT provision outside of the prescribed JCST UK curriculum has been described previously.[6] Luton et al reported that high stress states were significantly less likely, and mindfulness significantly higher in the ESRT intervention group ($p < 0.010$), and it was concluded that despite arduous emergency COVID rotas ESRT was feasible and, combined with protected time for trainees to engage, deserves further research to determine

TABLE 2. Two-Year Comparative Outcomes Related to ESRT Participation

ESRT Participation*		Full (n/% or Range)	Partial (n/% or Range)	None (n/% or Range)	p-value
Trainee number		13 (31.0)	11 (26.1)	18 (42.9)	
Training program	CST	10 (77.0)	8 (72.7)	14 (77.8)	0.950
	IST	3 (23.1)	3 (27.3)	4 (22.2)	
Ethnicity	WUKG	9 (69.2)	4 (36.4)	8 (44.4)	0.545
	BMEUKG	2 (15.4)	3 (27.3)	5 (27.8)	
	IMG	2 (15.4)	4 (36.4)	5 (27.8)	
Logbook number		173 (41-501)	144 (41-348)	137 (9-229)	0.597
Publications		1 (0-12)	1 (0-7)	1 (0-20)	0.691
MRCS Pass		9 (69.2)	7 (63.6)	9 (50.0)	0.341
ARCP 1/2/6 vs. 3/4		11 (84.6)	7 (63.6)	11 (61.1)	0.193
NTN Success		8 (61.5)	3 (27.3)	1 (5.6)	0.025
IST	GS	3 (23.1)	2 (18.2)	1 (5.6)	0.493
CST	T&O	3 (23.1)	1 (9.1)		0.230
	ENT	1 (7.7)			0.999
	Plastics	1 (7.7)			1.000

Table 2 outcomes are reported as whole or median numbers with percentages or ranges in parenthesis respectively.
ARCP, Annual Review of Competency Progress; BME, Black or Minority Ethnic; UKG, United Kingdom Graduate; IMG, International Medical Graduate; CST, Core Surgical Training Program; IST, Improving Surgical Training Program; MRCS, Membership to the Royal College of Surgeons; NTN, National Training Number; WBA, Work Based Assessment; GS, General Surgery; T&O, Trauma and Orthopedics; ENT, Otolaryngology.
*Intervention: >80% attendance of sessions; Non-completion: 0-80% attendance of sessions. Non-intervention: non-involvement).

TABLE 3. Repeated Measures Analysis of Variance (ANOVA) Regarding the Effect of ESRT on Trainee Psychological Wellbeing vs. Control

Outcome; Instrument	Mean Score (SD)		
	T1	T2	T3
Burnout; aMBI			
ESRT	4.81 (±2.79)	4.05 (±2.38)	3.14 (±2.25)
Control	4.64 (±2.88)	5.00 (±2.66)	5.14 (±2.35)
ANOVA		F 6.637, p = *0.002*, η_p^2 = *0.167*	
Stress; PSS-10			
ESRT	21.21 (±8.58)	16.86 (±7.60)	15.79 (±5.47)
Control	20.09 (±5.69)	22.22 (±5.74)	19.22 (±5.91)
ANOVA		F 8.740, p < *0.001*, η_p^2 = *0.200*	
Mindfulness; CAMS-R			
ESRT	18.07 (±5.06)	21.93 (±3.65)	20.57 (±2.93)
Control	20.09 (±5.60)	22.22 (±5.74)	19.22 (±5.91)
ANOVA		F 3.201, p= *0.047*, η_p^2 = *0.084*	
Depression; PHQ-2			
ESRT	1.50 (±1.51)	1.00 (±1.18)	0.93 (±0.92)
Control	2.00 (±1.10)	1.43 (±1.47)	1.38 (±1.40)
ANOVA		F 0.012, p < *0.988*, η_p^2 < *0.001*	
Anxiety; STAI			
ESRT	6.93 (±3.54)	5.79 (±3.91)	5.29 (±3.36)
Control	7.09 ± (3.32)	6.57 (±4.26)	7.78 (±3.88)
ANOVA		F 1.858, p = *0.166*, η_p^2 = *0.050*	

Results are reported as individual mean numbers with standard deviations in parenthesis.

aMBI, abbreviated Maslach Burnout Inventory; ANOVA, Analysis of Variance; CAMS-R, Cognitive Affective Mindfulness Scale-Revised; ESRT, Enhance Stress Resilience Training; PHQ-2, 2-item Patient Health Questionnaire; PSS-10, 10-item Perceived Stress Scale; STAI, State-Trait Anxiety Index; T1 baseline, Prior to the start of curriculum training; T2 Post-intervention, 8 weeks following completion of ESRT module; T3 end of Surgical Training program, 18 months following completion of ESRT module.

aMBI - higher score equates to more burnout; CAMS-R – higher score equates to greater mindfulness; PHQ-2 – higher score equates to increased depressive symptoms; PSS-10 – higher score equates to more stress; STAI – Higher score equates to more anxiety.

Partial Eta squared (η_p^2) represents the effect size for ANOVA analyses with cut off points (small effect <0.06, medium effect 0.06-0.14, large effect >0.14).

TABLE 4. Univariate and Multivariate Analysis of Two-Year Outcomes Related to NTN Appointment

		NTN Success (n/% or Range)	No NTN Success (n/ % or range)	Univariate Analysis		Multivariate Analysis	
				OR (95% CI)	p	OR (95% CI)	p
Trainees		12 (28.6)	30 (71.4)				
Training Program	CST	6 (50.0)	26 (86.7)	1		1	
	IST	6 (50.0)	4 (13.3)	6.5 (1.39-30.49)	0.018	5.2 (1.42-28.41)	0.022
Ethnicity	WUKG	5 (41.7)	16 (53.3)	1			
	BMEUKG	3 (25.0)	7 (23.3)	1.371 (0.25-7.39)	0.713		
	IMG	4 (33.3)	7 (23.3)	1.83 (0.37-8.94)	0.456		
Logbook number		187 (108-501)	143 (9-348)	1.009 (0.99-1.02)	0.086		
Publications		1 (0-12)	1 (0-20)	1.039 (0.87-1.24)	0.671		
MRCS Pass		11 (91.7)	14 (46.7)	12.571 (1.44-110.01)	0.022	17.128 (1.48-197.11)	0.023
ESRT participation*		8 (66.7)	5 (16.7)	10.00 (2.15-46.51)	0.003	13.249 (2.08-84.58)	0.006

Results are reported as individual numbers or median numbers with percentages or ranges respectively.

ARCP, Annual Review of Competence Progression; ESRT, Enhance Stress Resilience Training; MRCS, Membership of the Royal College of Surgeons; NTN, National Training Number.

*For the purpose of statistical analysis only those trainees who fully participated in the ESRT module were included into the MVA as those who partially participated were deemed to not have received the full potential benefit of ESRT.

medium-term efficacy.[6] Moreover, since conception in 2016, Enhanced Stress Resilience Training has become an integral part of a multi-disciplinary surgical intern training program at the University of California San Francisco[3] and several other North American and international institutions, including medical schools, who have incorporated this program into their generic curricula. ESRT has shown to have potential benefit to both trainee well-being and even executive function,[14] ultimately providing the surgical trainee with a cognitive toolkit to reduce the negative impact of the inevitable stresses associated with front-line healthcare delivery and the process of becoming a surgeon.[4]

Mindfulness-based resilience training (MT) has become integral to the training of other high-stress populations including the US Marine Corps, the French Police, and Swiss elite athletes.[15-18] Johnson et al in the first study of the effect of MT used multiple domains of measurement to examine mechanisms underlying recovery from stress in active-duty military personnel (US Marines) prior to deployment. Specifically: first, MT altered heart rate and breathing rate recovery following stressful training; second, MT modulated a strongly correlated set of peripheral biomarkers before, during, and after exposure to a stressful training session; third, neuroimaging results supported the hypothesis that MT affects brain structures that are important in integrating information about the internal physiological state and the body's response to stress. Le Scanff and Taugis reported on the implementation of a stress management program for French police Special Forces units. One hundred and fifty male police officers took part in the program with findings showing that the psychological training was very well received and led police management to consider factors and manifestations of stress in a more extensive way, resulting in stress management training initiated for all front-line police forces. Moreover, other groups (intelligence service and bodyguard detachments) asked for the training to be adapted to their specific work characteristics. Rothlin et al in the arena of elite sport (Switzerland) conducted a randomized controlled trial of differential and shared effects of psychological skills training and mindfulness training on performance-relevant psychological factors in sport. A total of 95 athletes from 4 sports (tennis, curling, floorball, and badminton, $Mean_{age}$ = 24.4 year, 51% male, 49% female) were randomly assigned into 3 groups: psychological skills training intervention (PST), mindfulness training intervention (MT), and wait-list control group (WL). Compared with WL, both interventions equally improved the ability to prevent emotions interfering with performance (probability >99%) and in controlling attention in training and competition (probability >89%). To a lesser extent, both interventions showed shared improvements in dealing with failure as shown by more action orientation (probability >82%). All studies concluded that mental training led to improvements in performance-relevant psychological factors, especially concerning the handling of environmentally generated emotions. Consequently, the findings of this study have a strong supportive context in the present literature.

This study has several inherent limitations. The study population itself encompasses a modest sample size, consisting of volunteers from a single SEB, with no randomized protocol. This study intended to include all participants in the intervention and consequently caution needs to be exercised in any subsequent comparison between participants and nonparticipants for example participation was voluntary and individuals who completed the training may be more independently driven to succeed. Primary and secondary outcome measures of this study will likely have been influenced by the effects of the COVID-19 pandemic which has also resulted in adaption and restricted access to ESRT course resources. The challenges of ESRT delivery in the UK is 3-fold and inherently different to that in the US; the COVID-19 pandemic has undoubtedly affected training, forcing ESRT to be delivered virtually due to social restrictions and the large geographical region, including 16 training sites, within the Statutory Educational Body (SEB). Financial limitations exist, especially about covering hospital service provision commitments to release trainees to attend sessions, and the cost of course delivery itself with diminishing UK School of Surgery budgets. From a Human factors perspective there are reported challenges in changing the mindsets of surgeons with regards to the efficacy of Mindfulness Based Stress Reduction therapies[19] with cultural difference potentially exaggerated when comparing US and UK trainees. Some of these limitations are offset by the novelty of the study, its clinical importance with regards to trainee health and wellbeing and its relevance for career progression.

Early years core surgical training, akin to post graduate year 3 to 4, is damaging, with almost three-quarters of trainees reporting burnout in at least one domain.[20] ESRT is a novel intervention aimed at mitigating the impact of the stresses associated with surgical training and has demonstrated significant improvements within US surgical resident programs. Improvements in mindfulness and wellbeing metrics reported in US studies have been reproduced within this UK cohort, implying that the ESRT curriculum is valid and applicable across different training environments. The striking improvements in NTN success suggest that increased mindfulness translates to improvement in training performance

and consideration should be given to launching ESRT as a fundamental clinical training component.

DECLARATION OF COMPETING INTEREST

Data, analytic methods, and study materials will be made available to other researchers on request from the corresponding author.

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