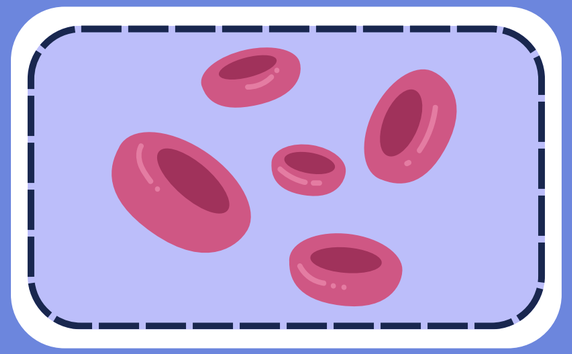
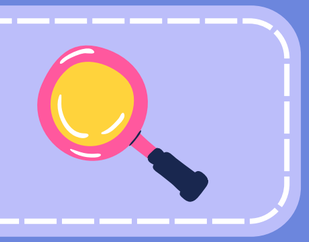


EFFECT OF EXAM STRESS ON THE IMMUNE SYSTEM

Juna Gregersen



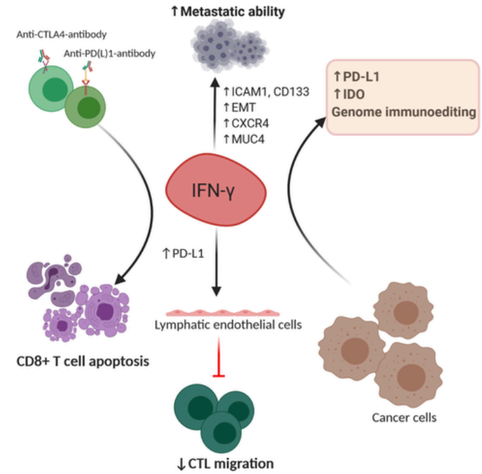
Introduction

- Purposes of the Research:
  - to understand how the immune system responds to test-taking stress specifically
  - comprehend immune system functions
- Immune system: defends the cells and stops infection with organs and cells.
- Immune system issues contribute to disease severity (heart diseases, diabetes).
- Stress heightens inflammation by initiating the fight-or-flight response (temporarily unless it's chronic).
- Cortisol can be positive but also reduce cellular adaptive immunity.

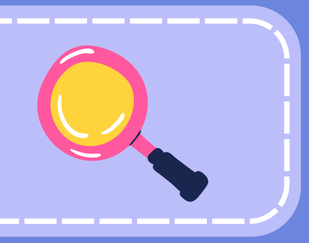
Introduction

Effect of general stress on immune system

- IFN-y ↘ --> "Th2 cytokine imbalance" – negative for antibodies
- pro-, anti- inflammatory cytokines ↗
- SOME ties to peripheral blood protein changes (blood vessels)
- decrease in glucocorticoid function (anti-inflammatory steroid hormone)
- white natural killer (NK) cells increase
- less proliferation (cell creation)



IFN-y (interferon gamma) - cytokine that calls for macrophages (fight against pathogens and particles over 0.5 µm)

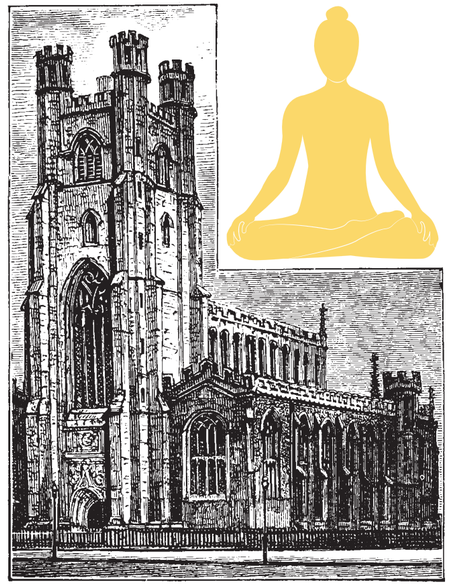


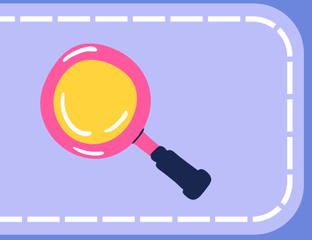
NIH Trial Purpose

Immune dysregulation among students exposed to exam stress and its mitigation by mindfulness training: findings from an exploratory randomised trial

Purpose:

- Make generalization on meditation's effect on exam stress and the immune system
- See the effects on Cambridge students specifically





NIH Trial Criteria

Criteria:

1. involved in the 2016 Mindful Student Study
2. exam, PhD paper, or dissertation from May 15 – July 15 2016 (due date range)

Excluded if:

- autoimmune disorder past, “severe allergy or asthma”
- steroid medication on a schedule
- alcohol or illegal drug addiction
- already underwent 8-week mindfulness program or meditation for over 10 hrs

NIH Trial Methods

Type of Study : exploratory (pre-Phase 1) randomized

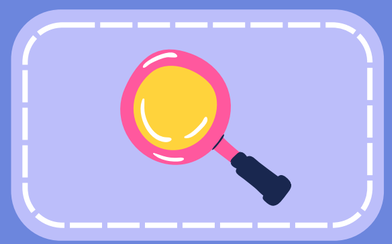
Measures:

- Initial distress, cytokines, cortisol data taken on the participants
- 2 blood tests, 22.5 mL (150 immune cells and molecules: IL and IFN, TNF) with immunophenotyping
- Clinical Outcomes in Routine Evaluation Outcome Measure (mental stress)
- Medical exam

General Methods:

- Informed consent
- Mindful Student Body




Results

Start Date – Jan 2016 – start and end date happened on schedule

Statistics

- 18 went to 1/2 of the mindfulness sessions (minimum)
- 3 didn't go
- 6 didn't say anything
- The sessions had no negative mental effects
- Attended 7 sessions median

(Possible) Confounding Variables

- Control = 28% overweight, 16% obese
- winter v. spring (measurements can change)

Results

Table 2

Outcome values for all time points and groups, and statistical tests for pre-post changes on the total sample.

	Control	27	0.9	0.54	0.76	0.03 to 0.2.32	27	1.05	0.52	1	0.06 to 2.06
	Total	53	0.91	0.51	0.82	0.03 to 2.32	52	1.03	0.56	0.96	0.06 to 2.29
Cortisol	MSS	26	313.65	123.48	325	109 to 518	22	324.55	201.82	300	121 to 992
	Control	27	353.96	199.15	303	118 to 896	25	289.32	168.97	205	119 to 781
	Total	53	334.19	166.06	316	109 to 896	47	305.81	183.87	228	119 to 992
IL-8	MSS	26	8.43	3.29	7.9	3.9 to 17.6	22	9.35	3.86	8.15	5.1 to 21.4
	Control	27	7.24	2.54	6.6	3 to 14.4	25	8.85	3.67	8.2	4.3 to 21.6
	Total*	53	7.82	2.97	7	3 to 17.6	47	9.08	3.72	8.2	4.3 to 21.6
TNF-α	MSS	26	1.78	0.43	1.75	1 to 2.7	22	2.12	0.7	1.85	1.4 to 4.2
	Control	27	1.74	0.39	1.7	1.2 to 3.1	25	1.97	0.43	1.8	1.5 to 3.5
	Total**	53	1.76	0.4	1.7	1 to 3.1	47	2.04	0.57	1.8	1.4 to 4.2
CRP	MSS	26	1.84	2.16	1.3	0.5 to 11.7	22	1.32	1.23	0.75	0.5 to 4.4
	Control	27	2.15	1.89	1.4	0.9 to 8.8	25	1.78	2.24	1	0.5 to 9.4
	Total*	53	2	2.01	1.4	0.5 to 11.7	47	1.57	1.83	1	0.5 to 9.4
% $CD4^+$ T Lymphocytes	MSS	24	0.62	0.1	0.64	0.33 to 0.75	20	0.6	0.09	0.62	0.45 to 0.73
	Control	26	0.65	0.11	0.66	0.39 to 0.82	25	0.59	0.1	0.59	0.33 to 0.76
	Total*	50	0.63	0.1	0.65	0.33 to 0.82	45	0.6	0.1	0.62	0.33 to 0.76
% $CD8^+$ T Lymphocytes	MSS	24	0.23	0.1	0.21	0.14 to 0.58	20	0.28	0.08	0.26	0.18 to 0.47
	Control	26	0.19	0.08	0.17	0.09 to 0.5	25	0.29	0.08	0.29	0.15 to 0.5
	Total***	50	0.21	0.09	0.18	0.09 to 0.58	45	0.29	0.08	0.28	0.15 to 0.5
% $CD19^+$ B Lymphocytes	MSS	24	0.15	0.09	0.14	0.03 to 0.37	19	0.22	0.08	0.21	0.05 to 0.34
	Control	26	0.16	0.07	0.16	0.05 to 0.29	25	0.25	0.09	0.23	0.08 to 0.4
	Total***	50	0.16	0.08	0.16	0.03 to 0.37	44	0.23	0.08	0.23	0.05 to 0.4
% $CD14^+$ Monocytes	MSS	24	0.35	0.12	0.33	0.12 to 0.6	18	0.42	0.1	0.4	0.22 to 0.61
	Control	26	0.38	0.1	0.37	0.16 to 0.58	24	0.45	0.12	0.47	0.22 to 0.61
	Total**	50	0.37	0.11	0.36	0.12 to 0.6	42	0.43	0.11	0.42	0.22 to 0.66
% NK cells	MSS	24	0.25	0.13	0.21	0.09 to 0.63	18	0.29	0.13	0.29	0.11 to 0.49
	Control	26	0.18	0.09	0.15	0.06 to 0.44	24	0.24	0.11	0.22	0.08 to 0.54

*p < 0.05; **p < 0.01; ***p < 0.001. All p values are adjusted for multiple comparisons. Abbreviations: MSS: Mindfulness Skills for Students course; NK: natural killer.

- Cortisol, IL-8, TNF-A (pro-inflammatory)
- lower ranges increased but some higher ranges decreased (CD4, CRP, CD8)
- B lymphocites

mune system. Several factors related to inflammation were significantly increased the second time participants were sampled, which was during the exam period: IL-8 (*p < 0.05), TNF-α (**p < 0.01), $CD8^+$ T cells (***p > 0.001), B cells (***p < 0.001), monocytes (**p < 0.01), and NK cells (**p < 0.01). Conversely, CRP (*p < 0.05), CD4+ T cells (*p < 0.05) were significantly decreased (after correction for multiple comparison test-

Conclusion

Conclusive Statements

When distress increases, B cells numbers also do (“chronic tissue inflammation”). Mindfulness techniques are unsuccessful in decreasing these cell numbers, though they decrease distress.

Conclusion/ Personal Limitations

Mindfulness increases NK cell abilities for women with breast cancer (related study).

It focused on the effect of meditation on the immune system but increased my personal interest about the answers to exam stress.

Professional Limitations

The study found it difficult to measure cytokine, had small sample size, and didn’t intensively analyze NK and B cells.

References

Turner, Lorinda et al. Immune dysregulation among students exposed to exam stress and its mitigation by mindfulness training: findings from an exploratory randomised trial. Sci Rep, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7118166/. [Pub Meb Central]