More on the acute effect of waterpipe tobacco smoking

Yazeed Toukan

September 2017

Ruth
Ruth Rappaport Children's Hospital
Rambam Health Care Campus

Introduction

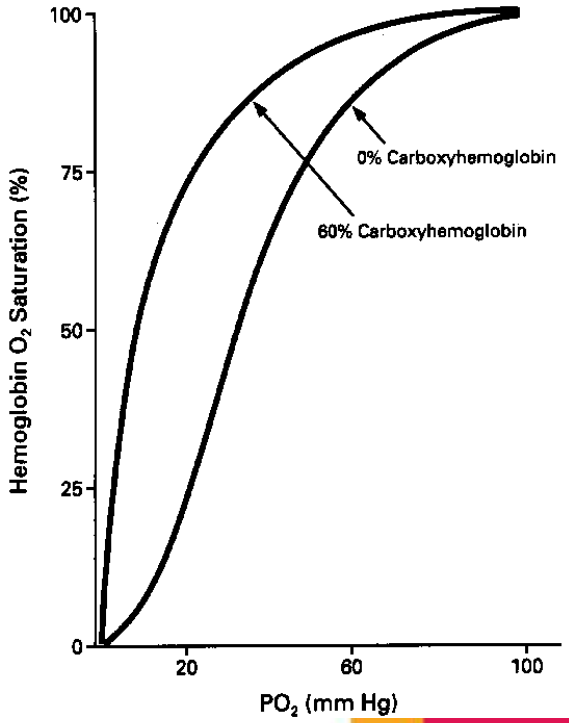
- **Waterpipe smoking** (WPS) is a social custom common in Asia, the Middle East and North Africa
- In recent years has gained popularity also in Europe and the United States
- **Teenagers: 12-15%**

Toxic effect of CO

- As we previously showed, one session of WPS results in increase in **COHb** reaching to comparable levels seen in acute CO poisoning

The main hypothesis

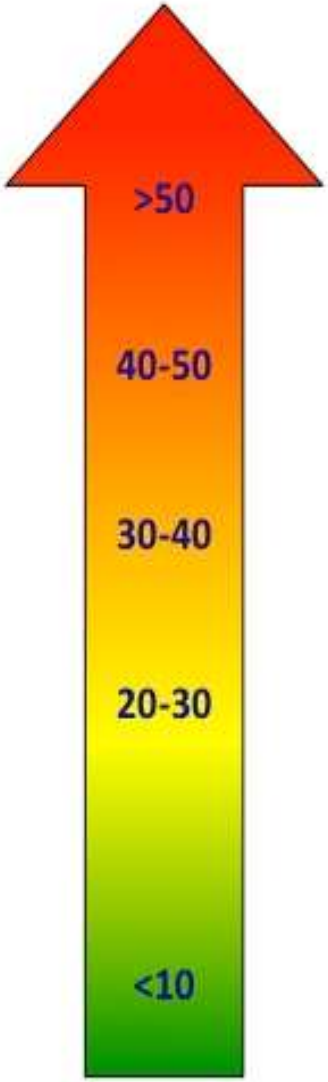
- A mechanism of tissue hypoxia d/t
  - ↓ O_2-carrying capacity
  - ↓ ability to release O_2 to tissues



Toxic effect of CO

Other hypotheses

- The influence of CO on the mitochondrial respiratory chain complex
  - production of free radicals (reactive O_2 species)
  - increase in the production and release of NO
  - the effect on vital organs electrolyte channels



Death (especially if not removed from exposure)

Seizure, Unconsciousness, Heart Attack

Confusion, Blurred Vision, Shortness of Breath, Pounding Headache, Uncontrolled "Sleep", Vertigo, Loss of Coordination, Chest Pain, Memory Loss

Impaired Judgment, Difficulty Breathing, Blurring of Vision, Bad Headache, Increasing Drowsiness, Stomach Pain

Drowsiness, Headache, slight increase in Respiratory Rate, Dizziness

Slight Headache, Nausea

None

Waterpipe smoking & cognition

- The possible effect of WPS on the cognition and short-term memory has not been evaluated

- One study performed on an animal model **(after WPS)**
  - ↓ in cognitive performance
  - ↑ in oxidative stress at the hippocampus level

K. Alzoubi et al; The Effect of Waterpipe Tobacco Smoke Exposure on Learning and Memory Functions in the Rat Model. J Mol Neurosci (2015) 57:249–256

In our study…

- **Our hypothesis** was that a single session of WPS for 30 min, will significantly increase serum CO, and may have a negative effect on cognitive performance

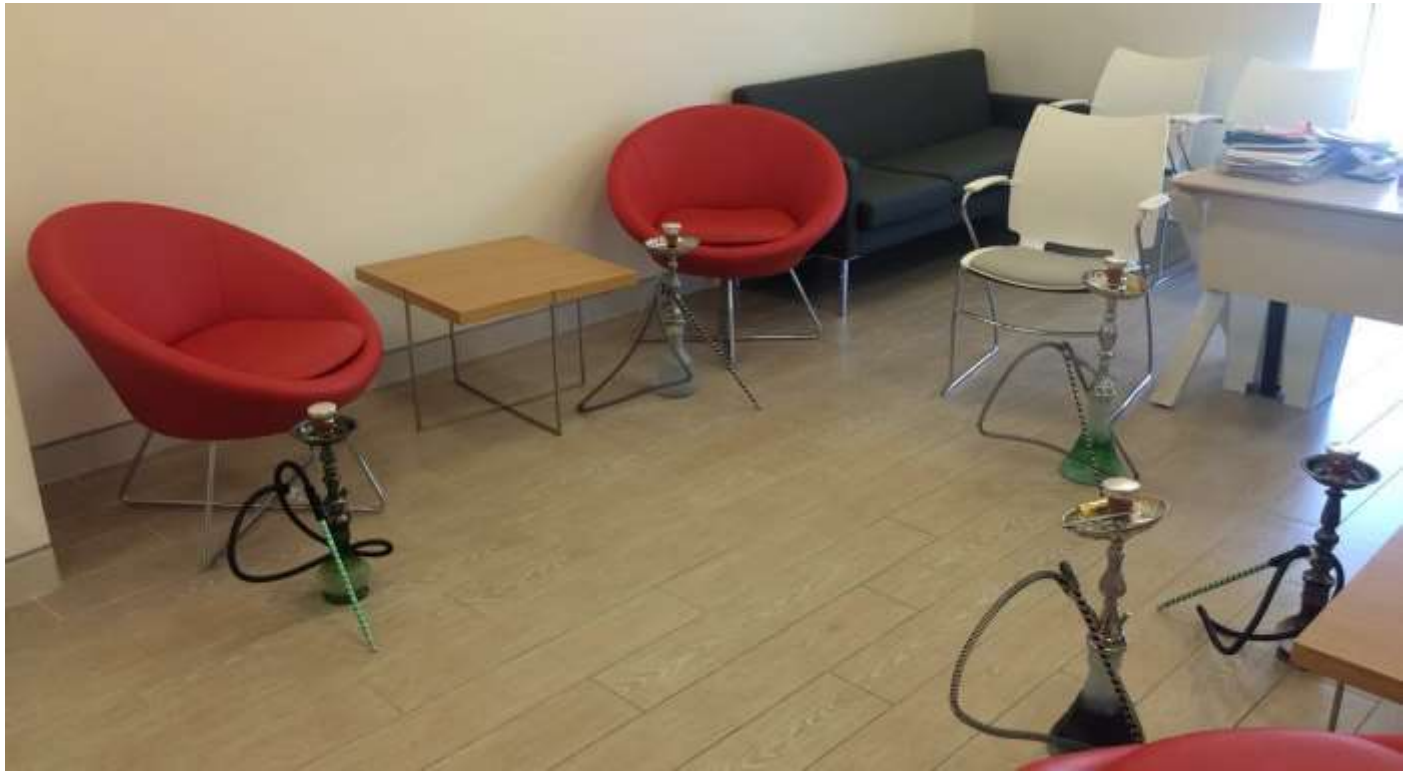
- **Our aim** was therefore, to evaluate the acute effect of a 30 min WPS on the cognitive tests

Participants

Inclusion criteria	Exclusion criteria
Age > 18 yr	Age < 18 yr
Previously experienced WPS	A volunteer who never smoked waterpipe
	Pregnant women
	Acute viral or bacterial illness in the last 2wk
	Orally or IV steroid treatment
	WPS during the past 24 hr
	Cigarette smoking during the last 6 hr
	Massive exposure to fire smoke during last 24 hr

Study design

- This is a prospective study, which was carried out in indoor setting



Preparation of Narguilé

Mu‘assel: 30% tobacco & 70% honey [10gram]

Ruth
Ruth Rappaport Children's Hospital
Rambam Health Care Campus

Study design

- The volunteers were evaluated before & 30 min after a single session of WPS

- The evaluation included:
  - Cognition tests: Digit Span task & PASAT test
  - Vital Signs (BP, RR, HR, Sat.)
  - Spirometry (FEV1, FVC, $FEF_{25\%-75\%}$)
  - LCI
  - Serum Carboxyhemoglobin
  - Serum Nicotine
  - Serum Cytokines

Digit span task

- To assess working memory capacity

8. זכירת ספרות

הפסק לאחר כשלון ב- 2 הנסיונות של פריט כלשהו.
תן את 2 הניסיונות של כל פריט גם אם הנבדק מצליח בנסיון הראשון.

ספרות קדימה:

פריט	נסיון 1	נסיון 2	ציון
.1	1 - 7	6 - 3	
.2	5 - 8 - 2	6 - 9 - 4	
.3	6 - 4 - 3 - 9	7 - 2 - 8 - 6	
.4	4 - 2 - 7 - 3 - 1	7 - 5 - 8 - 3 - 6	
.5	6 - 1 - 9 - 4 - 7 - 3	3 - 9 - 2 - 4 - 8 - 7	
.6	5 - 9 - 1 - 7 - 4 - 2 - 8	4 - 1 - 7 - 9 - 3 - 8 - 6	
.7	5 - 8 - 1 - 9 - 2 - 6 - 4 - 7	3 - 8 - 2 - 9 - 5 - 1 - 7 - 4	
.8	2 - 7 - 5 - 8 - 6 - 2 - 5 - 8 - 4	7 - 1 - 3 - 9 - 4 - 2 - 5 - 6 - 8	
		ציון גולמי מקס. 16	

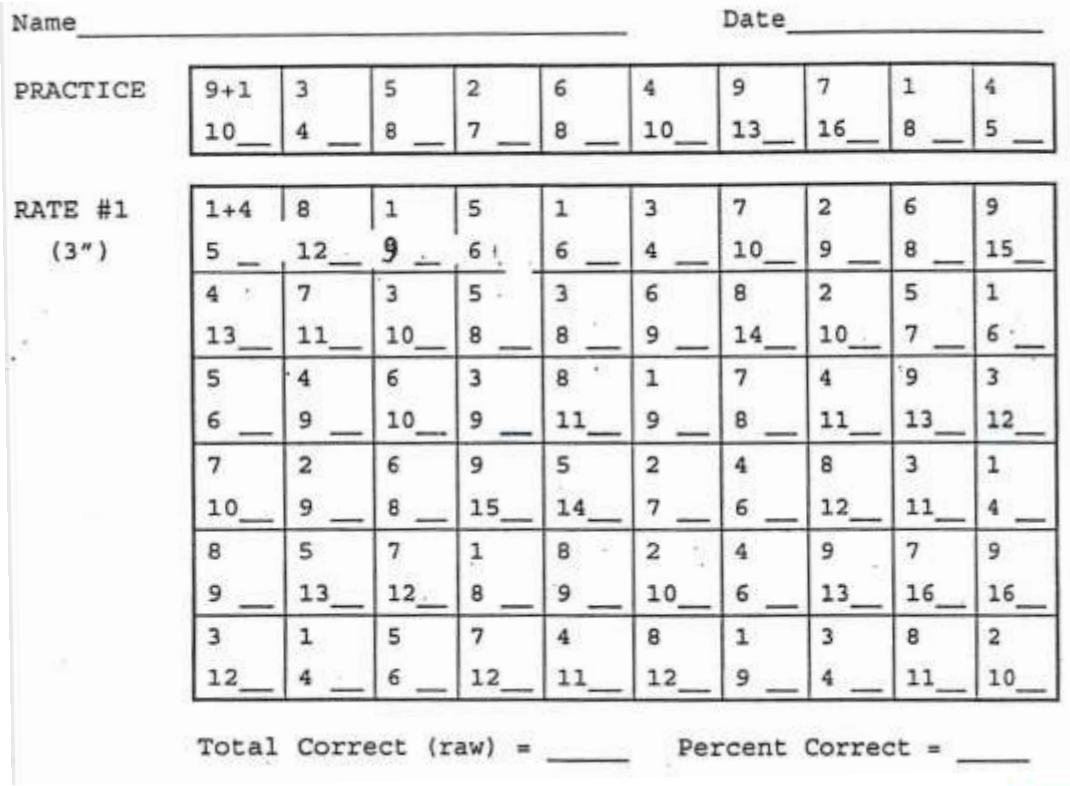
ספרות אחורה:

פריט	נסיון 1	נסיון 2	ציון
.1	2 - 4	5 - 8	
.2	6 - 2 - 9	4 - 1 - 5	
.3	3 - 2 - 7 - 9	4 - 9 - 6 - 8	
.4	1 - 5 - 2 - 8 - 6	6 - 1 - 8 - 4 - 3	
.5	5 - 3 - 9 - 4 - 1 - 8	7 - 2 - 4 - 8 - 5 - 6	
.6	8 - 1 - 2 - 9 - 3 - 6 - 5	4 - 7 - 3 - 9 - 1 - 2 - 8	
.7	9 - 4 - 3 - 7 - 6 - 2 - 5 - 8	7 - 2 - 8 - 1 - 9 - 6 - 5 - 3	
		ציון גולמי מקס. 14	

The PASAT test

(Paced Auditory Serial Addition Test)

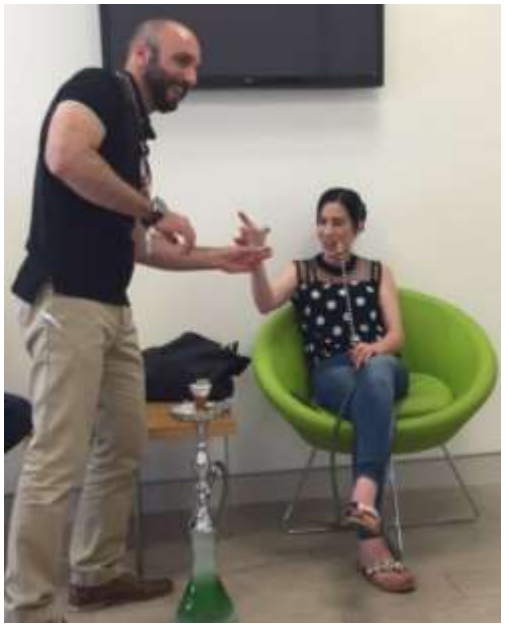
- To assess:
  - auditory information processing speed and flexibility
  - calculation ability



Name _____ Date _____

PRACTICE	9+1 10__	3 4 __	5 8 __	2 7 __	6 8 __	4 10__	9 13__	7 16__	1 8 __	4 5 __
RATE #1 (3")	1+4 5 __	8 12__	1 9 __	5 6 __	1 6 __	3 4 __	7 10__	2 9 __	6 8 __	9 15__
	4 13__	7 11__	3 10__	5 8 __	3 8 __	6 9 __	8 14__	2 10__	5 7 __	1 6 __
	5 6 __	4 9 __	6 10__	3 9 __	8 11__	1 9 __	7 8 __	4 11__	9 13__	3 12__
	7 10__	2 9 __	6 8 __	9 15__	5 14__	2 7 __	4 6 __	8 12__	3 11__	1 4 __
	8 9 __	5 13__	7 12__	1 8 __	8 9 __	2 10__	4 6 __	9 13__	7 16__	9 16__
	3 12__	1 4 __	5 6 __	7 12__	4 11__	8 12__	1 9 __	3 4 __	8 11__	2 10__

Total Correct (raw) = _____ Percent Correct = _____



Ruth
Ruth Rappaport Children's Hospital
Rambam Health Care Campus

Results

Scale	Volunteers (n=35)
Age (yr)	25.6±4.5
Male	24 (69%)
BMI	24.7±4.5
WPS (ever)	35

Results – Vital signs

		Mean	Median	Min	Max	P
Heart rate	Before	85.371	82.000	67.0	117.0	P=0.001
	After	95.457	96.000	59.0	126.0	
Oxygen saturation	Before	98.857	99.000	96.0	100.0	P=0.84
	After	98.914	99.000	96.0	100.0	
Systolic BP	Before	132.057	135.000	102.0	169.0	P=0.28
	After	134.371	133.000	96.0	173.0	
Diastolic BP	Before	74.086	76.000	60.0	90.0	P=0.46
	After	74.914	75.000	47.0	93.0	
Respiratory rate	Before	15.257	16.000	12.0	20.0	P<0.0001
	After	19.171	18.000	13.0	36.0	

Results – Vital signs

- Similar to our previous studies, ↑ **HR & RR**
- BP did **not** change in the current study
- Nicotine activates **sympathetic system** with a release of epinephrine, NE, vasopressin and affects endothelium

Results – PFTs

		Mean	Median	Min	Max	P
FEV1 %	Before	96.229	98.000	73.0	116.0	P=0.059
	After	95.343	98.000	65.0	117.0	
FVC %	Before	92.000	93.000	68.0	108.0	P=0.61
	After	92.343	95.000	69.0	110.0	
FEF 25-75%	Before	97.686	95.000	64.0	141.0	P=0.02
	After	94.400	92.000	49.0	142.0	
LCI	Before	6.5149	6.4300	5.20	8.70	P=0.12
	After	6.2789	6.2700	5.12	7.60	

- Similar to our previous studies ↓ **$FEF_{25-75\%}$** , ↓ **FEV1** (borderline)

- Similar to cigarette smoking – leading to chronic lung dis.

Results – PFTs

- This is the **first study** evaluating **LCI** in WPS – no change
  - Is **LCI** less sensitive than **$FEF_{25-75\%}$** to acute change?
  - Is it a sample size error?

Results – COHb & Nicotine

		Mean	Median	Min	Max	P
COHb	Before	2.606	2.200	0.7	6.8	P<0.0001
	After	11.511	10.700	4.2	30.6	
Serum Nicotine	Before	5.5029	1.2000	0.20	37.40	P<0.0001
	After	29.2171	26.8000	5.40	61.60	

- Similar to our previous studies
  - COHb reaching toxic levels, ~15 cigarettes
  - Nicotine reaching toxic levels, ~4 cigarettes

Results – COHb

Criteria for **hyperbaric oxygen therapy**

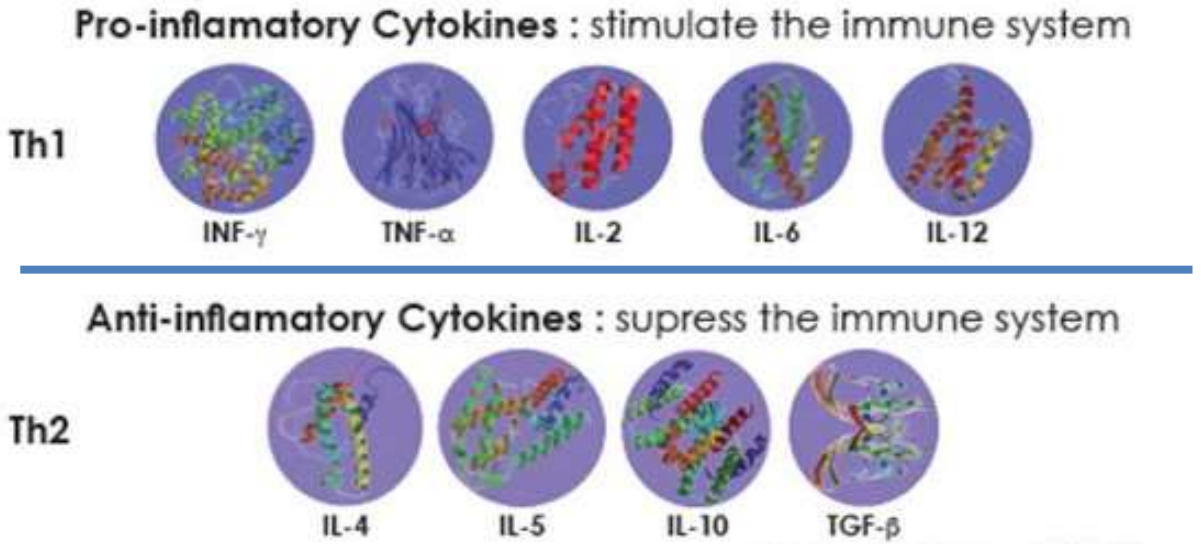
- COHb > 25%
- IHD with COHb > 15%
- Pregnant with COHb > 10%
- Angina/Ischemia by ECG
- Metabolic acidosis
- Abnormal neuropsychiatric testing
- History of unconsciousness
- Symptomatic after 4h 100% O_2

Results – Serum Cytokines

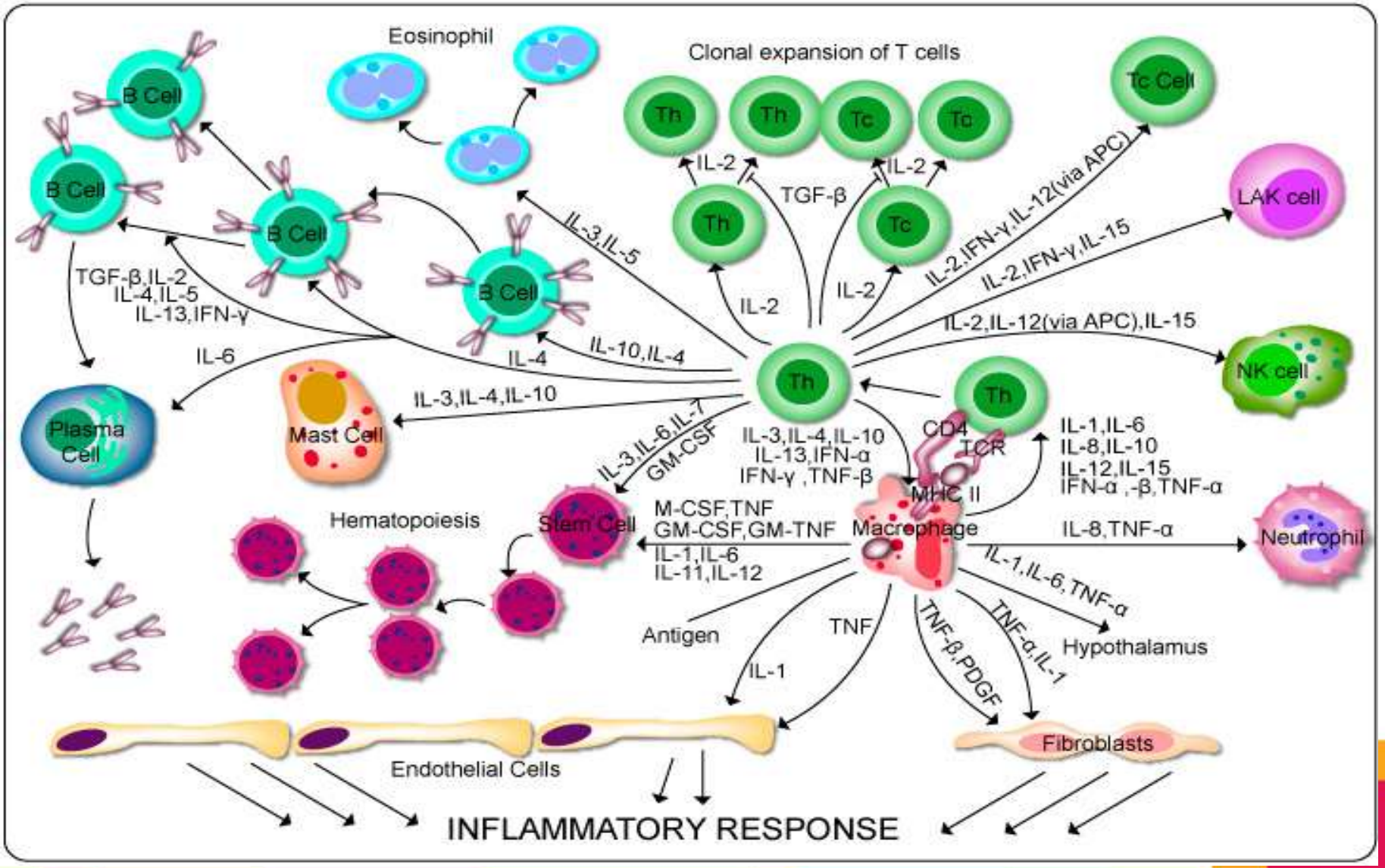
		Mean	Median	Min	Max	P
IL-2	Before	4.7197	4.6660	1.09	8.15	P<0.0001
	After	17.0686	16.7320	11.08	24.58	
IL-6	Before	1.2083	1.1730	0.14	2.81	P<0.0001
	After	4.9880	4.6780	2.28	8.93	
IL-10	Before	7.4692	7.3040	2.80	11.72	P<0.0001
	After	3.3975	3.3460	0.43	8.65	
IL-5	Before	5.3561	5.0570	0.24	19.25	P=0.04
	After	5.0741	4.1670	0.58	18.04	

Results – Serum Cytokines

- ↑ IL-2; ↑ IL-6
- ↓ IL-10; ↓ IL-5
- ↔ TNF-α; ↔ TGF-β



Results – Serum Cytokines



Results – Serum Cytokines

- This is the **first study** evaluating serum cytokines in acute WPS

- The change in cytokines investigated are probably associated with the chronic lung inflammation and may have clinical implications

Results – Cognition tests

		Mean	Median	Min	Max	P
Digit Span	Before	15.4000	16.0000	8.00	25.00	P=0.003
	After	14.2857	15.0000	6.00	18.00	
PASAT	Before	46.4714	49.0000	25.00	60.00	P=0.009
	After	49.1000	52.0000	26.00	60.00	

Nicotine & cognition

- Improved PASAT d/t repeat test**?**
- Or the effect of increased nicotine**?**

- Nicotine has both positive and negative effects on various cognitive domains

- d/t a structural similarity with acetylcholine → the probable reason for better cognitive performance (?)

Control group

- 20 healthy young adults

- **<u>Evaluation</u>:**
  - Cognition tests, 30min apart, **without WPS**

Results – control vs “smokers”

		Mean	P
Digit Span Pre_Post	Smokers	-1.11	**p= 0.006**
	Control	0.4	
PASAT Pre_Post	Smokers	+2.63	**p= 0.001**
	Control	+6.95	

Conclusions

- One session of WPS leads to multiple biological changes that might lead to significant health problems
  - ↑ HR; ↑ RR
  - ↓ $FEF_{25-75\%}$
  - ↑↑ COHb; ↑↑ Nicotine
  - ↑ IL-2; ↑ IL-6; ↓ IL-10; ↓ IL-5

Conclusions

- Adverse cognitive tests compared to non-smokers

- Awareness must be raised towards the possible immediate cognitive impairment of WPS which may affect **real time** reaction

Limitations

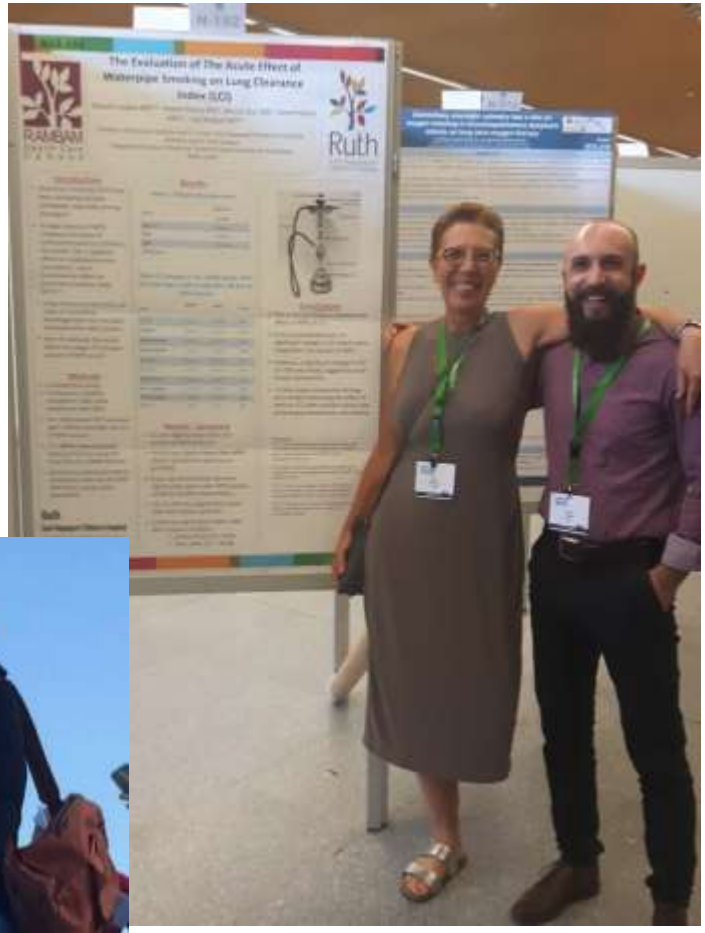
- Small sample size
- Short-term “session”
- Adults smokers vs teenagers
- Indoor setting

Conclusions

- Further larger prospective & long-term studies evaluating the effect of WPS on cognition, LCI, and other multiple clinical and physiological parameters, are needed

Thanks…

- Prof. Bentur
- Dr. Hakim
- Dr. Gur
- Hadas Cohen
- Ronit Leiba



Ruth
Ruth Rappaport Children's Hospital
Rambam Health Care Campus

Thanks…

- "**MALKAM**" - Clinical Research Grant for residents
- "**Sharon Foundation**" - Grant for excellency in medical care and scientific achievements
- The Israel Lung Association
- Cognitive Neurology Institute
- Clinical Toxicology & Pharmacology Lab.

Special Thanks

شُكراً...

- Dr. Elemy Ameer
- Monnera Hanna

Ruth
Ruth Rappaport Children's Hospital
Rambam Health Care Campus