"Cigarette Smoke and Effects on Health"

Manuela Martins-Green
and Junior Colleagues

Department of Cell Biology and Neuroscience
University of California, Riverside
Facts about Cigarette smoking

- Smoking-related diseases kill 1 in 10 adults globally. If the same rate continues, by 2030 smoking will kill 1 in 6 people.
- Someone dies every 8 sec from tobacco use.
- Every cigarette smoked cuts at least 5min of life on average – about the time it taken to smoke it.
- Every minute 10 million cigarettes are sold.
- Half of long-term smokers will die from tobacco smoking.
Facts about Cigarette smoking

- Among young teens (aged 13 to 15) worldwide, about 1 in 5 smokes.
- Evidence shows that around 50% of those who start smoking as adolescents go on to smoke for 15 to 20 years more.
- Peer-reviewed studies show teenagers are heavily influenced by tobacco advertising.
Facts about Cigarette smoking

- It is an important factor in heart disease, stroke and chronic lung disease.
- At least 25% of all deaths from heart diseases and about 75% of the world’s chronic bronchitis are related to smoking.
- It can cause cancer of the lungs, larynx, oesophagus, mouth, and bladder, and contributes to cancer of the cervix, pancreas, and kidneys.
Types of Cigarette Smoke

First-Hand Smoke

Mainstream Whole smoke (MSW)

Second-Hand Smoke

Sidestream Whole smoke (SSW)

The composition of both smokes is very similar but for most components the concentrations are higher in the second-hand smoke.
Mouse Smoking Machine

Mice in chamber are exposed to smoke for 6 hours a day, with 5 minutes break between 10 minute periods of smoking.
Wound Healing

Normal

- Response to injury
- Inflammation
- Angiogenesis
- Myofibroblast differentiation

Abnormal

Toxicants

- Cigarette Smoke
- Skin

Impaired WH
Effects of MSW on the Mitochondria

Control  MSW  MSW+SOD+CAT
Effects of SSW on the Endomembrane system
Effects of SSW on the Endomembrane system
CCAF, IL-8 and MCP-1 in Wound Healing

Normal
- Response to injury
- Inflammation
- Angiogenesis
- Myofibroblast differentiation

Abnormal
- Toxicants
  - Cigarette Smoke
  - Atherosclerotic plaque and liver disease

Impaired WH
Lipid Accumulation in Liver Tissue of the Mice Exposed to SSW

![Graph showing comparison of total cholesterol and triglyceride levels between control (C) and SSW groups.](image)

- **Total Cholesterol (mg/g wet weight)**
  - C: 20 ± 2
  - SSW: 24 ± 2
  - N.S.

- **Triglyceride (mg/g wet weight)**
  - C: 4 ± 1
  - SSW: 12 ± 2
  - **"**
Lipid Accumulation in Liver Tissue of the Mice Exposed to SSW
Mechanism of Lipid Production by Hepatocytes

AMPK = Adenosine monophosphate kinase

SREBP = Sterol regulatory element binding protein

ACC = Acetyl-CoA carboxilase
Mechanism of SSW-induced lipid accumulation in hepatocytes

AICAR (5-aminimidazole-4-carboxamide-1-β-D-ribofuranoside) activates AMPK.

We showed that it reverses SSW effects on lipid accumulation in the liver.

Yuan et al., J. of Hepathology, 51:535, 2009
Plasma levels of pro-inflammatory cytokines

**MCP-1 (pg/ml)**

- **Control**
- **SSW**

**Time**
- 14 week
- 1 year

- **Control**
- **SSW**

**TNFα (pg/ml)**

- **Control**
- **SSW**

- **14 week**
- **1 year**

**IFN-γ (pg/ml)**

- **Control**
- **SSW**

- **14 week**
- **1 year**

**IL-4 (pg/ml)**

- **Control**
- **SSW**

- **14 week**
- **1 year**
Wound Healing

Normal
- Response to injury
- Inflammation
- Angiogenesis
- Myofibroblast differentiation

Abnormal

Toxicants
- Cigarette Smoke
- Cornea

Impaired WH
Tβ4 Plus Dexamethasone Reverses the SSW Inhibition of Cornea Healing

Importance of these findings:

Both anti-inflammatory agents and Tβ4 have been approved by the FDA and hence these findings can be taken right into the clinic.
Third Hand Smoke (THS) also known as residual or aged tobacco smoke.

It is derived from the accumulation of tobacco toxins from second hand smoke (SHS) over and over again, on surfaces of a particular compartment.

Examples are:

(i) The upholstery of car seats as well as the dash board and window glass.

(ii) In a family room on the curtains, carpet, upholstery of sofas and chairs, throw blankets, pillows etc. This smoke is also present in the hair of smokers, in their clothing, and on their skin.
Nicotine is highly sorptive

This results in surfaces in environments where smoking is habitual to be loaded with large amounts of this alkaloid.

As a consequence re-emission of nicotine from indoor surfaces continues long after smoking ceases.

Nicotine adsorbed to a model surface showed high reactivity towards HONO, leading to the formation of three TSNAs: 1-(N-methyl-N-nitrosamino)-1-(3-pyridinyl)-4-butanal (NNA), 4-(methylNitrosamino)-1-(3-pyridinyl)-1-butanone (NNK) and N-nitroso nornicotine (NNN) which are known carcinogenes.
THS = Third Hand Smoke

➢ Today there is virtually no realization in the population that THS is a danger to their health.

➢ A recent study by Winickoff from Harvard Medical School showed that only 65.2% of non-smokers and 43.2% of smokers believe that THS is harmful to children and elderly people living in the house of smokers.
Children who live in the household of smokers who smoke inside the house have more byproducts of THS in the urine than do children whose parents smoke outside the house and these more than children of non-smokers.

Children who live in multi-unit housing apartments where their parents do not allow smoking have 140% higher blood cotinine levels than children who live in detached housing (Wilson et al. 2011).
Levels of cotinine in the urine of infants:

- Infants of “Never Smokers” had levels of 0.33 ng/ml
- Infants of “No indoor smoking” had levels of 2.32 ng/ml
- Infants of “Direct exposure” had levels of 15.47 ng/ml

Nicotine in infants hair for:

- Never smoker-0.53 ng/mg
- Outdoor smoker-2.75 ng/mg
- Direct exposure-5.95 ng/mg
Current Martins-Green Lab Group

Funding: NCI, NIGMS, NAIAD, AHA and TRDRP
Lesson

Don’t smoke and do not spend time in environments where smoking is allowed.

Thanks you for listening.