Studies that Show a Risk of Cancer from Exposures to Cellphone Radiation

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Topics

- Group 2B (possible) Human Carcinogen
- Risk parameters; Measurement Parameters
- Brain Tumors
- Blood-Brain Barrier
- Hearing Nerve (Acoustic Neuroma) Tumors
- Salivary Gland Tumors
- Eye Tumors
- Leukemia
- Breast Tumors
- Sperm Damage and Testicular Cancer
- Distance Is Your Friend
- “Safe Enough”

Group 2B (possible) Human Carcinogen

- 2001
  - World Health Organization's (WHO) International Agency for Research on Cancer (IARC) declares electricity's magnetic fields (ELF MF) a Group 2B (possible human carcinogen)
  - Substantially based on studies of risk of leukemia and brain tumors from exposure to ELF MF
    - Publishes 445 page Monograph-80 detailing the science
- 2011
  - WHO's IARC declares radio frequency radiation (RFR) is a Group 2B Carcinogen
  - Substantially based on studies of risk of brain cancer and hearing nerve tumor from cellphone RFR radiation.
    - Publishes 480 page Monograph-102 detailing the science

Risk Parameters & Study Design

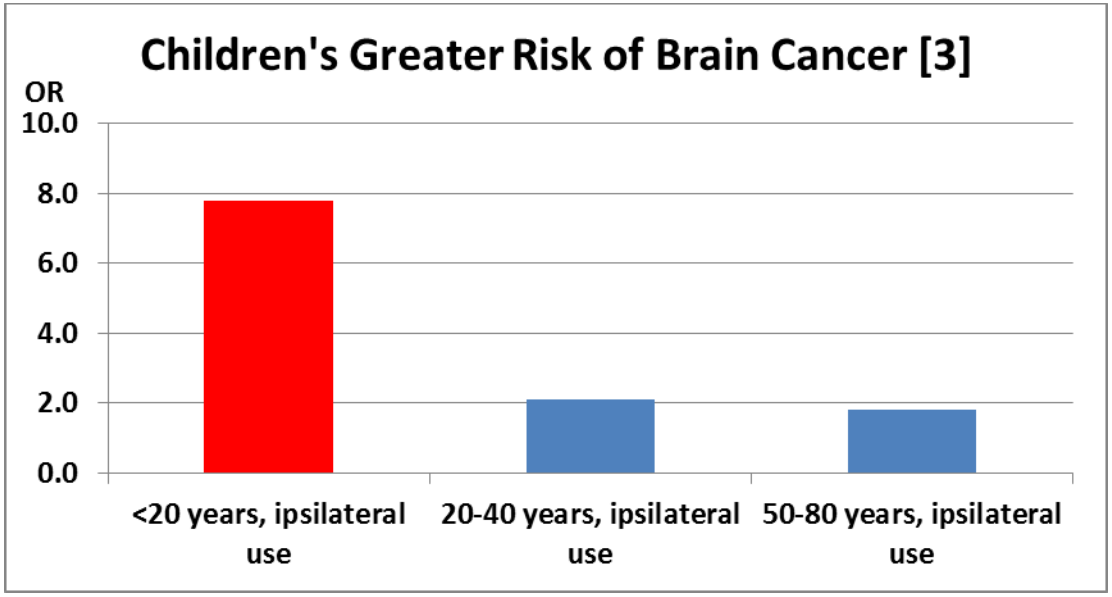
- Risk
  - OR, Odds Ratio
- Confidence level of risk
  - In science ≥95% confidence is called "statistically significant"
    - 95% confidence interval (95% CI)
- Example: OR=4.2, 95% CI=1.2-12
  - Risk increased 4.2-fold with a 95% confidence the risk is between 1.e-fold and 12-fold
- Case-Control Study Design (C-C)
  - Cases have the disease; Controls do not have the disease
    - Cases and Controls can be exposed or not exposes
      - Controls are often matched by age, gender, region, etc. to Cases
- p-value: Probability of a chance finding
  - $p \leq 0.05$ is "statistically significant," ≥95% confidence
  - $p \leq 0.10$ is "borderline significant," ≥90% confidence
    - **Significance is a continuum, not a given value**

Measurement Parameters

- Power density
  - Watts per square centimeter (W/cm^2)
- Specific Absorption Rate (SAR)
  - SAR: Power absorbed by weigh of tissue (W/kg)
    - For a given weight of tissue SAR is written as:
      - SAR_{1g} or SAR_{10g}, etc..
- Specific Absorption (SA)
  - Total absorbed energy over time (J/kg)
    - W/kg*s=(J/s)*s=J/kg
- Electric field (EF)
  - Volts per meter (V/m)
  - SAR is proportional to square of electric field (EF^2)
- Magnetic field (MF), exists only with electric current
  - milli-Gauss (mG) or micro-Tesla (μT)
    - 1 mG=10 μT

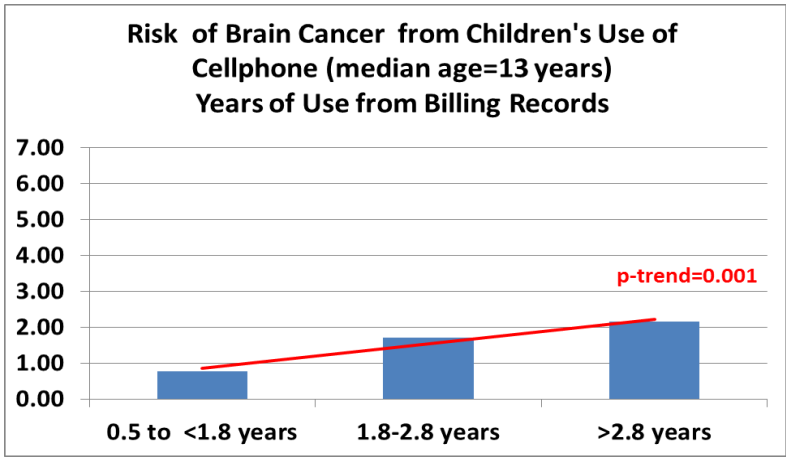
Brain Tumor Studies, Children

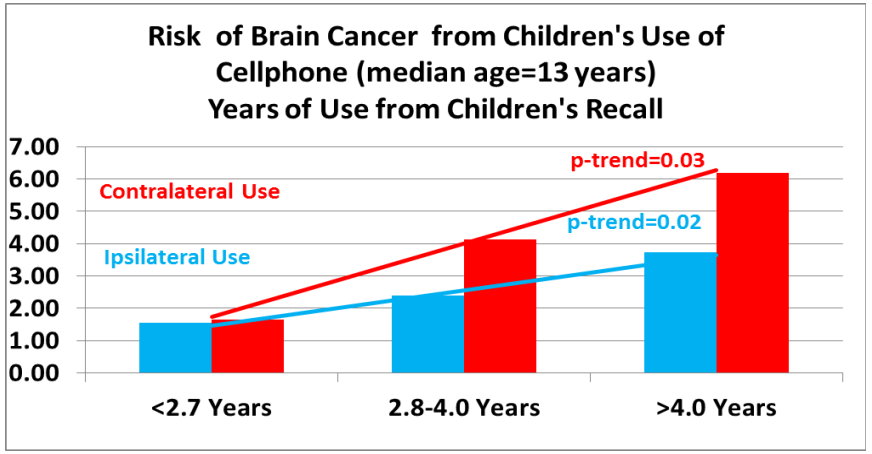
- Children have greater risk than adults (C-C) [1]
  - Ipsilateral use (phone held to same side of head as tumor)
    - First use as a teenager or younger
      - OR=7.8, 95% CI=2.2-28
    - First use 20-40 years
      - OR=2.1, 95% CI=1.5-2.9
    - First use 50-80 years
      - OR=1.9, 95% CI=1.3-2.5



Brain Tumor Studies, Children

- CEFALO study of children and adolescents (C-C) [2]
  - Only study to date of children and adolescents
    - » Median age, 13 years
      - ***Exposure-response relationship*** (increased exposure, increased risk)
      - P-trend





Abstract's conclusion

"The absence of an exposure–response relationship either in terms of the amount of mobile phone use or by localization of the brain tumor argues against a causal association."

Lesson: ***Read the whole paper, not just the conclusion***

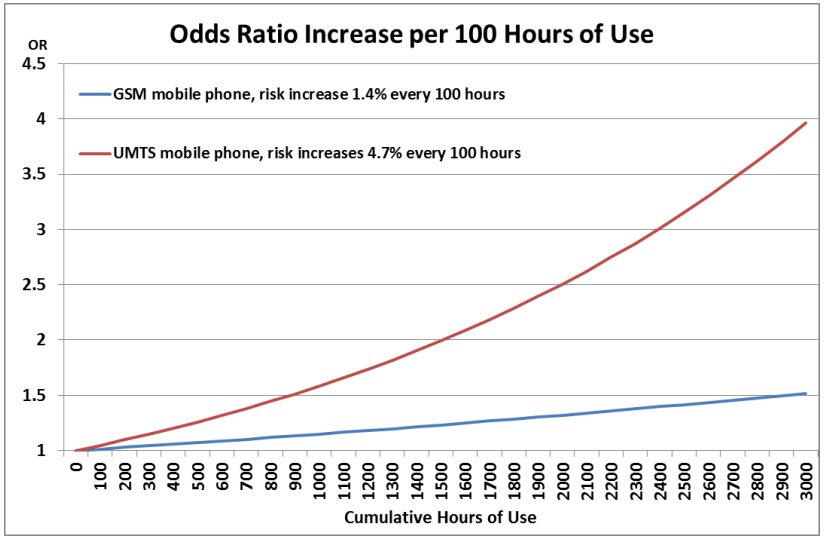
Brain Tumor Studies, Adults

- 13-country Interphone Study (C-C), risk of brain cancer [3]
  - 1640+ hours of use, OR=1.82, CI=1.15-2.89, p<0.001
    - » Compared to <5 hours of use
  - 10+ years since first use, OR=2.18, CI=1.43-3.31, p<0.0001
    - » Compared to 1 to 1.9 years of use
- Swedish study (C-C), risk of brain cancer [4]
  - >25 years of wireless* phone use, OR=3.0, CI=1.7-5.2, p<0.0001
    - » >25 years, temporal lobe cancer, OR=4.2, CI=1.9-9.1, p<0.001
  - >1,486 hours of wireless phone use, OR=2.0, CI=1.6-3.6, p<0.001
  - Percentage increased risks per every 100 hours of cumulative use
    - » 2G, GSM modulation, OR=1.4%, CI=0.9%-1.8%, $p<10^{-8}$
    - » 3G, UMTS modulation, OR=4.7%, CI=0.2%-9.3%

* Cell and cordless phone

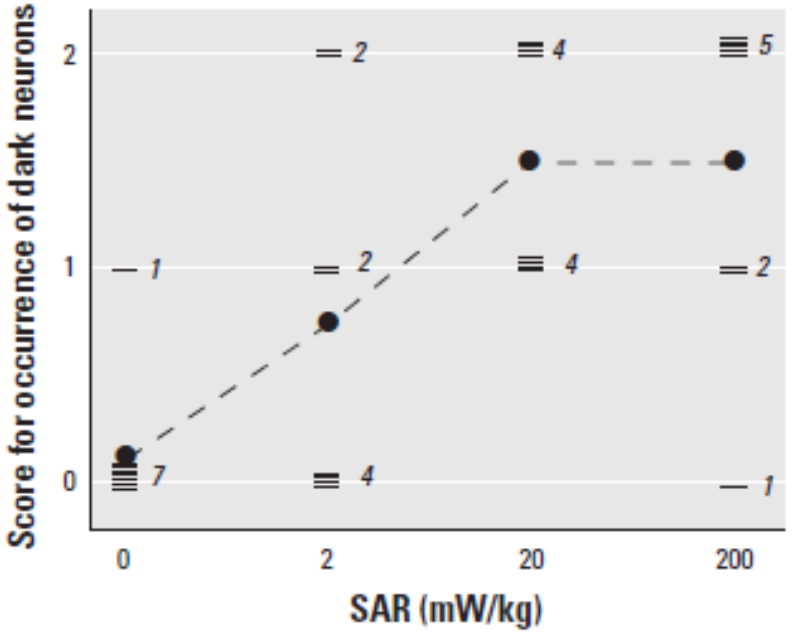
Counter-Intuitive Result

- Swedish study (C-C), risk of brain cancer [4]
  - Percentage increased risks per every 100 hours of cumulative use
    - 2G, GSM modulation, OR=1.4%, CI=0.9%-1.8%, $p<10^{-8}$
    - 3G, UMTS modulation, OR=4.7%, CI=0.2%-9.3%
  - 2G, GSM phone's average radiated power: Tens of mW
  - 3G, UMTS phone's average radiated power: Tens of µW
    - » **1,000 time *less* power, 3.4-times higher risk** (4.71/1.4=3.4)
  - DNA repair genes: > damage of UMTS modulation vs GSM



Blood-Brain-Barrier (BBB)

- The BBB protects the brain from molecules normally found in the blood
  - For example, albumin molecules (normal in blood)
    - Albumin in brain kills neurons
- Microwave radiation (MWR) weakens the BBB [5]
- A "Dark neuron" is a dead neuron
  - Dark neuron concentration versus SAR (W/kg)
  - SAR=0.002 W/kg, threshold
  - SAR=0.02 W/kg, saturation
  - SAR_{limit}=2.0 W/kg
    - 2,000 mW/kg
  - Neuron death begins 1,000 below the SAR exposure limit



Swedish Occupational Study and BBB

- Risk of *brain cancer* from occupational exposures [6]
  - Organic solvents: 50% increased risk
  - Herbicides and pesticides: doubled risk
  - Lead: quadrupled risk

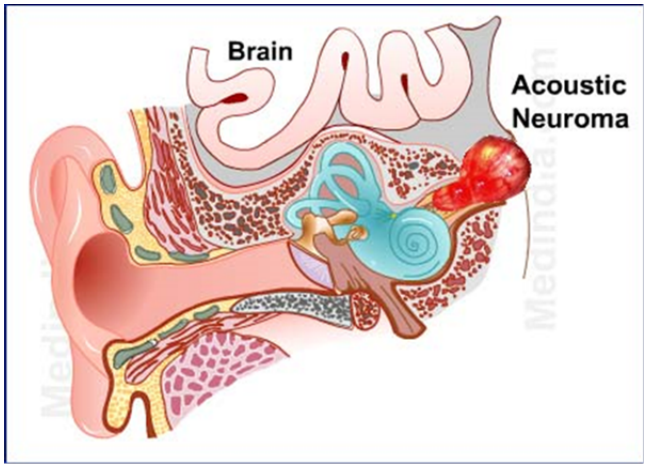
- *But risk of brain cancer only when when combined with electromagnetic radiation (EMR)*

- **No risk of *brain cancer* from each exposure alone, including EMR**

- ***Probable example of increased BBB permeability?***

Tumor of the Hearing Nerve (acoustic neuroma)

Symptoms:
Ringing in ear
Deafness

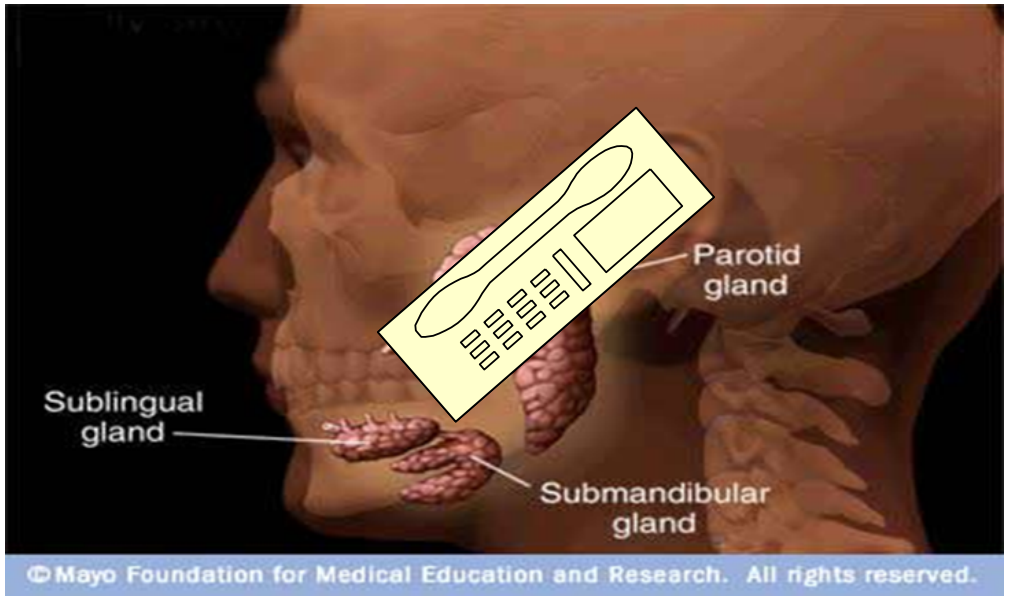


Surgery:
Deafness
Facial paralysis risk

- Swedish study (C-C) [7]
  - >20 years since first use of wireless (cell & cordless) phone
    - OR =4.4, 95% CI= 2.2-9.0, p<0.0001
  - Analog phone use: increased tumor volume with increased exposure
    - 10.3% increase per 100 hours of cumulative wireless use
- Korean study (C-C)[8]
  - Increased tumor volume with increased exposure
    - 8.8% increase with >2,000 hours of use Vs <2000 hours
- 13-country Interphone study (C-C) [9]
  - Ipsilateral use: tumor on same side as where cellphone was used
    - ≥10 years use with ≥1,640 hours, OR=3.74, 95% CI =1.48-8.83, p<0.01

Salivary Gland Cancers:

- Largest salivary gland: parotid gland
  - Chinese study (C-C) [10], >2.5 average hours of use per day
    - Epithelial gland cancer OR=**15.9**, 95% CI=6.0-42.2, $p<10^{-7}$
    - Mucoepidermoid cancer, OR=**31.3**, 95% CI=10.8-90.5, $p<10^{-10}$



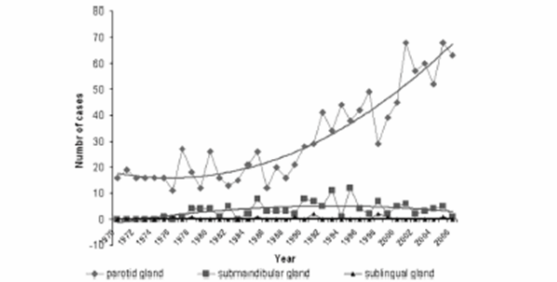


FIGURE. For trend analyses, we added regression lines and calculated R^2 values. Parotid gland cancer: $R^2 = 0.83$; Submandibular gland cancer: $R^2 = 0.36$; Sublingual gland cancer: $R^2 = 0.02$.

Since 2002
Tripled in Israel, 20% under age 20 [11]

Eye Cancer (uveal melanoma)
located in the eye's iris

- **Case-control study in nine European countries [12]**
- Risk is higher in women than men and higher for dark color eyes than light color eyes
  - Exposure: working at electrical substations
    - » Women, OR=3.76, 95% CI=0.77-18.4, *p<0.09*
    - » Men, OR=1.21, 95% CI=0.54-3.10, *p>0.6*
  - Exposure to computer screens
    - » Dark color eyes, OR=**30.6**, 95% CI=1.42-6.61, p<0.01
    - » Light color eyes, OR=1.03, 95% CI=0..69-1.54, *p>0.8*
    - » Women with dark eyes, OR=5.88, 95% CI=1.15-30.1
    - » Men with dark eyes, OR=3.02, 95% CI=1.20-4.64, p<0.01
- **German study (C-C)** [13]
  - Transmitting devices, OR=3.0, 95% CI=1.4-6.3
  - Probable/certain mobile phone use, OR=4.2, 95% CI=1.2-12.5

Leukemia

- **Risk of leukemia in Thailand (C-C)** [14]
  - » **AML**: Acute myeloid leukemia, **CML**: Chronic myeloid leukemia
  - » Exclusive use of GSM phone, OR=3.0, 95% CI=1.4-6.4, p<0.001
  - » Work with or near powerlines, AML OR=5.5, 95% CI=1.4-21
  - » Exposure to benzene, AML OR=4.9, 95% CI=1.4-17
  - – **Occupational application of pesticides**
    - » CML **OR=11**, 95% CI=3.8-33, p<0.00001
    - » Any myeloid leukemia, OR=4.9, 95% CI=2.3-10, p<0.0001
    - » AML OR=2.9, 95% CI=1.1-7.7
  - – Combined risk of chemicals and electromagnetic radiation (EMR)
    - » ***An effect of increased blood-brain-brain permeability?***
- **Risk of leukemia in UK**, (C-C) *borderline significant* risks [15]
  - – ≥15 years since first cellphone use, AML OR=2.08, 95% CI=0.98-4.39
  - – 10-15 years cellphone use, CML OR=1.99, 95% CI=0.94-4.22

Female Breast Cancer

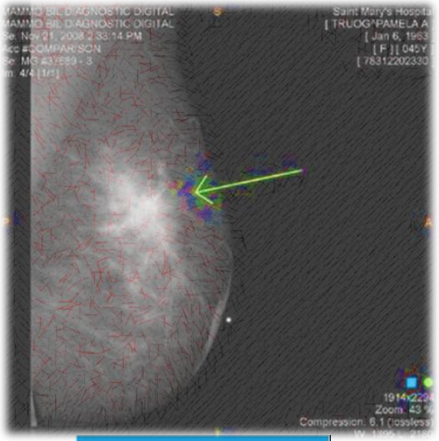
- Risk of placing cellphone in bra or shirt pocket [16]
  - Multiple primary breast cancers: Reports from case study.

1. "A 21-year-old female presented with left spontaneous bloody nipple discharge. Her history was notable for keeping her cellular phone tucked into her bra on the left side for several hours each day."
2. "A 21-year-old female presented with a palpable breast mass in the area where her cellular phone was kept in direct contact with her left breast. She had been placing her cellular device in her bra for eight hours a day or longer for the past six years."
3. "A 33-year-old female presented with two palpable masses in the upper outer quadrant of her right breast directly underneath where her cellular phone was placed against her breast in her bra. She had been placing her cellular phone in her bra intermittently for eight years. In the two years prior to diagnosis she would routinely place her phone in her bra while jogging 3-4 times per week. During this time period she would use a global positioning system (GPS) application on her cellular phone to determine her location while jogging. MRI demonstrated at least six suspicious lesions …"
4. "A 39-year-old female presented with three palpable breast masses in the area of cellular phone contact with her right breast. She had been placing her cellular phone in her bra while commuting and using a Bluetooth device to talk for hours each day for the past ten years."

Female Breast Cancer

- Risk of placing cellphone in bra or shirt pocket [16]

Dominican Republic, Credit Thos Robinson, 2010



Invasive three primary tumors in 39 year old Chinese-American who used cellphone in her bra 4 hours/day for 7 years

Images and associated text courtesy of Devra Davis

ENVIRONMENTAL HEALTH TRUST

Sperm Damage & Testicular Cancer

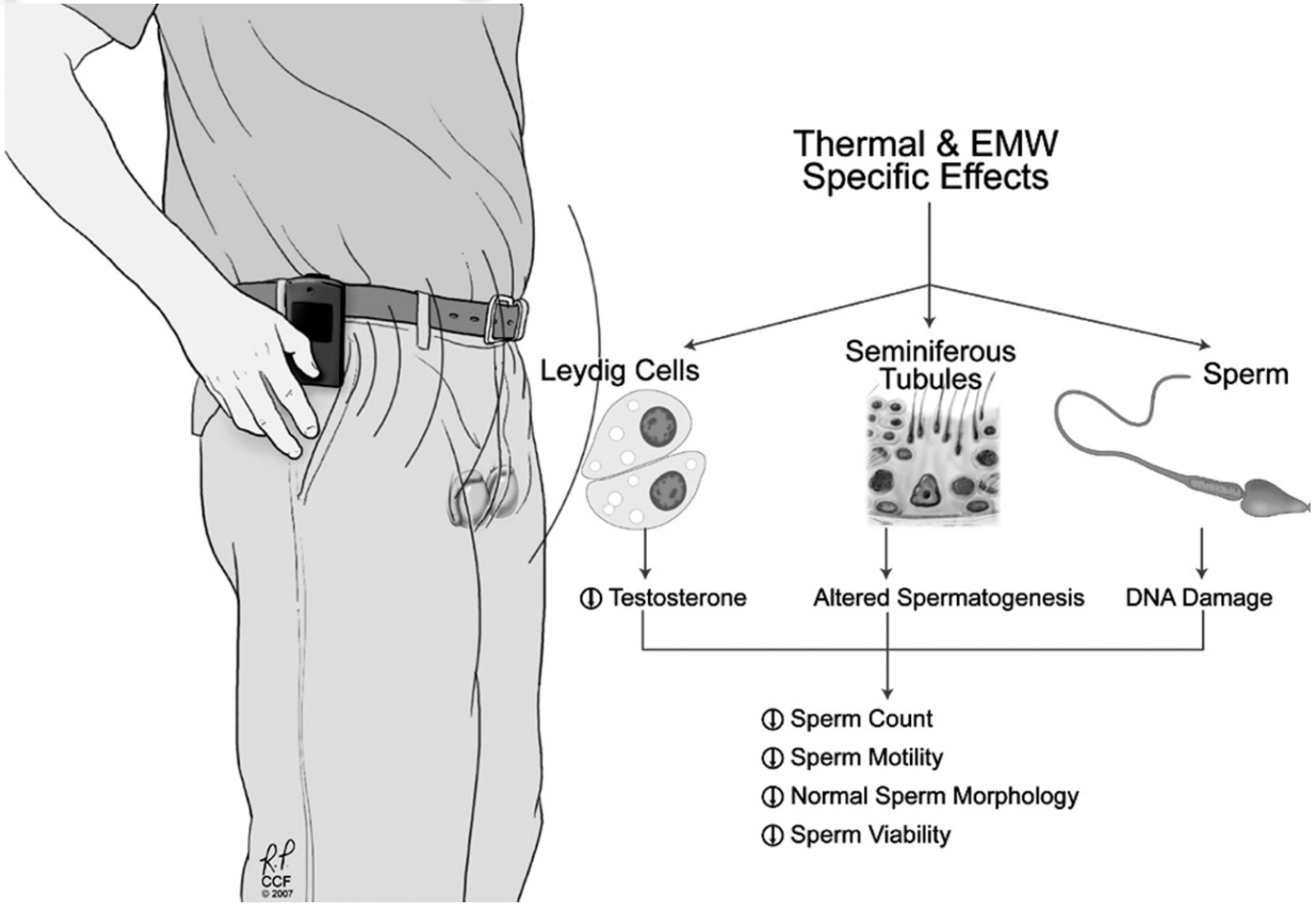
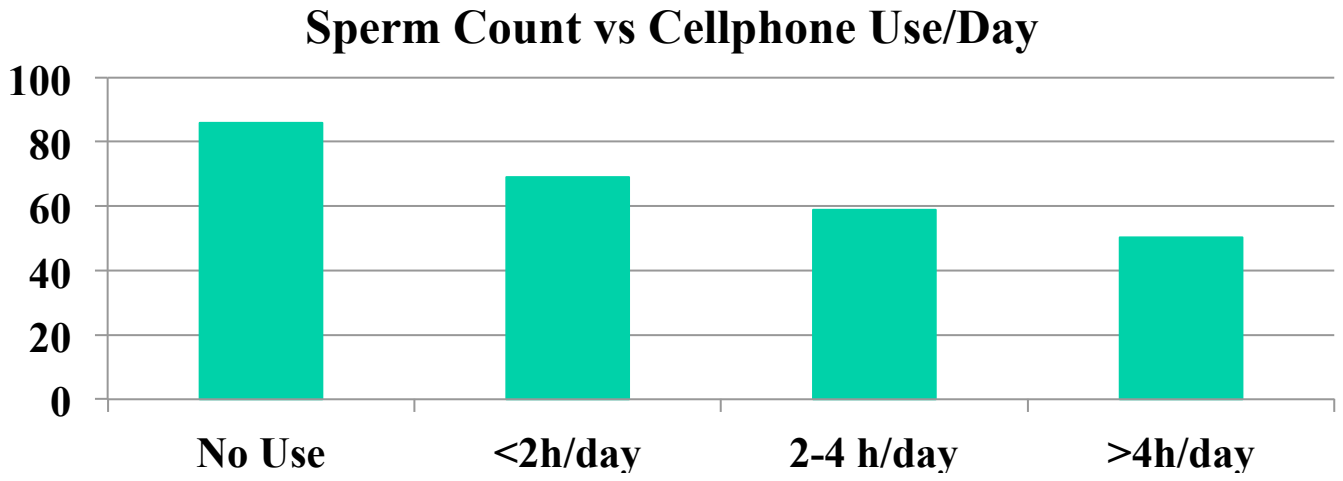
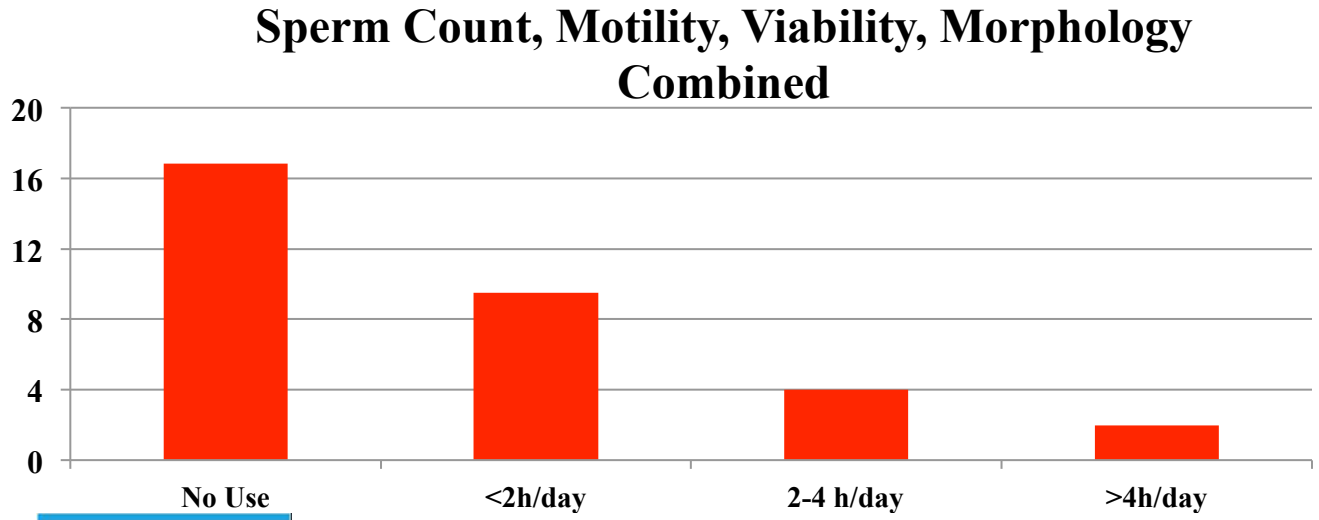


Image courtesy of Dr. Ashok Agarwal, Cleveland Clinic

Sperm Damage

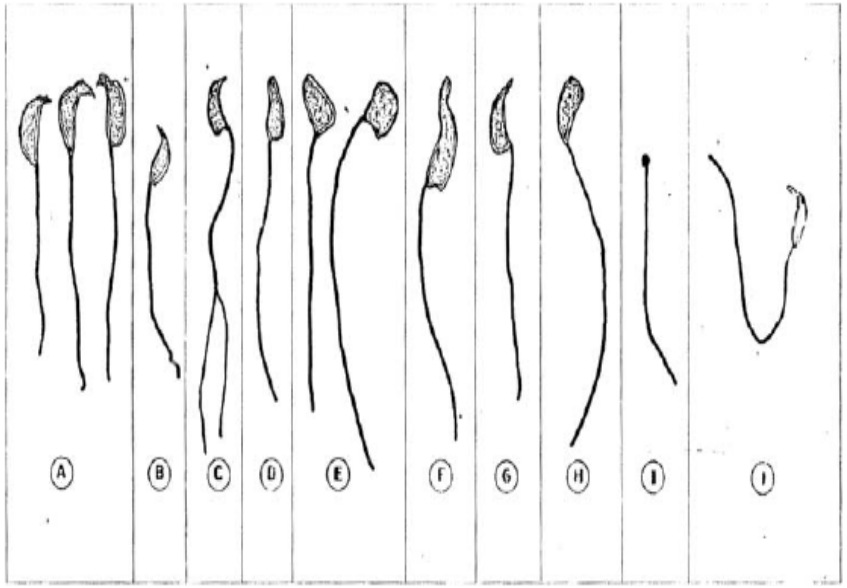
- Effect of cellphone use on sperm [17]





Damaged Sperm

- USA Study: Six hours/day over 18 weeks, abnormal clumping of sperm cells [18]
- UK study: “This study suggests …a significant genotoxic effect on epididymal spermatozoa is evident” [19]
- Nigeria study: Sperm head abnormalities in mice [20]

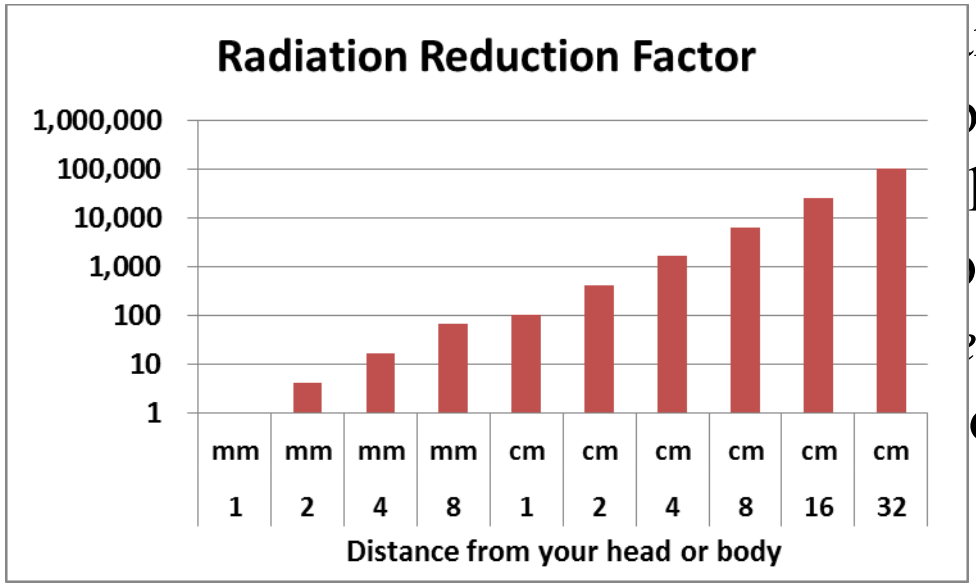


Testicular Cancer

- Only one study (C-C) published to date (2006)
  - Use of wireless phone and risk of seminoma testicular cancer[21]
    - Seminoma cancer is most common type
      - Ipsilateral risk of testicular cancer (left pocket , left testicle; right pocket, right testicle
      - OR=1.8, 95% CI=0.97-3.4, *p<0.07*
    - No risk non-seminoma testicular cancer

"Distance Is Your Friend"

- The radiation emitted by a cellphone decrease very rapidly as the distance from you head or body increases
  - "The Inverse Square Law"



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"safe enough."

- Do not place a cellphone to your ear
- Do not keep it on you body
- Do use headsets, use speaker mode

Minimize Your Exposures: "Safe-Enough"

1. Minimize your time on the phone
   - Risk is proportional to total lifetime hours of use
2. Avoid use when there are few bars
   - The more bars, the less radiated power
3. Keep as far as possible from other radiation sources
   - *Distance Is Your Friend*, Keep Away from:
     - Cell towers,
     - Wi-Fi routers
4. Avoid use in metal enclosures
   - Elevators
   - Cars, Buses, Trains
5. Parents' responsibilities
   I. Don't use a baby monitor; don't buy wireless "toys"
   II. Establish *age appropriate rules*, for example:
      a. No cellphone in bedroom at night
      b. Use of wired headsets
      c. Amount of use per day, week, month

Asante Sana

Maswali Yoyote?

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