

# Cell Phone Use Affects Brain Glucose Metabolism

Susan Jeffrey

**February 23, 2011** - Use of a cell phone for as little as 50 minutes at a time appears to affect brain glucose metabolism in the region closest to the phone's antenna, a new study shows.

Investigators used positron emission tomography (PET) during cell phone use in the on and then off positions and found that although whole-brain metabolism was not affected, metabolism was increased in the orbitofrontal cortex and the temporal pole areas of the brain while the cell phone was on, areas that are close to where phone's antenna meets the head.

## Dr. Nora Volkow

"We do not know what the clinical significance of this finding is, both with respect to potential therapeutic effect of this type of technology but also potential negative consequences from cell phone exposure," said lead study author Nora D. Volkow, MD, from the National Institute on Drug Abuse in Bethesda, Maryland, during a teleconference.

In the interim though, she recommends using hands-free devices or speaker-phone mode to avoid direct contact of the telephone with the head. Previous work suggests that if the phone is a foot or more away it is very unlikely to have any effects, she said. "So there are some very easy solutions that don't cost anything for those who want to play it safe."

Caution may be particularly necessary for children and adolescents whose neural tissue is still eveloping, Dr. Volkow noted. This is also a population who started their lives with cell phones and can expect to be exposed for years to come, she added.

Their report appears in the February 23 issue of the Journal of the American Medical Association.

## Effect of Imaging Tools?

The proliferation of cell phone use has raised the question of the effects of radiofrequency-modulated electromagnetic fields (RF-EMFs), particularly carcinogenic effects. Epidemiologic studies looking at the relationship between cell phones and brain tumors have been inconsistent with some, but not all, studies finding increased risk, "and the issue remains unresolved," the study authors write.

Dr. Volkow is well known for her work in the area of addictions, not generally adverse effects of cell phone use, but this new study nevertheless stemmed from that research, she said. They have been studying whether imaging technologies, including PET and magnetic resonance imaging (MRI), that are used to study the brain can directly affect brain function. "For the past 15 years, we've done a series of studies to try to actually assess whether magnetic fields affect brain glucose metabolism," Dr. Volkow explained.

They found, for example, that the static magnetic field of a 4-T MRI does not affect brain metabolism, she said. However, when the magnetic fields were changed rapidly, which produces electrical currents, there was a significant increase in glucose metabolism in the brain. They wondered whether the RF-EMFs produced by cell phones might do the same thing.

The current study was a randomized, crossover study that enrolled 47 healthy, community-dwelling subjects. All underwent PET with (18F)fluorodeoxyglucose injection twice for 50 minutes at a time, once with a cell phone at each ear but only the right phone on, although it was muted, and once with both cell phones off.

They found that whole brain metabolism was not significantly different with the phone on vs off. However, metabolism in the regions closest to the antenna, the orbitofrontal cortex and temporal pole, was significantly higher when the cell phone was on.

### **Table. Brain Metabolism in Area Closest to Antenna With Cell Phone On vs Off**

Endpoint	On Mode	Off Mode	Mean Difference (95% CI)	P
Metabolism in area closest to antenna, $\mu\text{mol}/100\text{ g per minute}$	35.7	33.3	2.4 (0.67 - 4.2)	.004

CI = confidence interval

The difference between off and on modes was about a 7% increase in glucose metabolism, within the range of physiologic activation during speaking, for example, she said.

The increases in activation also correlated significantly with the estimated electromagnetic field amplitudes for both absolute metabolism ( $R = 0.95$ ) and for normalized metabolism ( $R = 0.89$ ,  $P < .001$  for both).

It's possible that the activation would be even higher in subjects who are actually talking on the phone, but in this study they did not want the subjects to talk during imaging, which might have activated other brain areas and confounded the cell phone's effects, she said.

Unfortunately, Dr. Volkow noted, these findings don't shed any light on the controversy of whether cell phone exposure produces or does not produce cancer. "What it does say to us is that the human brain is sensitive to this electromagnetic radiation," she said. Whether this has any negative consequences needs to be evaluated.

They powered the study to detect even small effects, Dr. Volkow added. If they had not seen any effect after 50 minutes of exposure, "it would have been much easier to dismiss any concern about potential negatives of cell phones," she said. "But the fact that we are observing changes really highlights the need to do the studies to be properly able to answer the question of whether cell phone exposure can have harmful effects or not."

It's also possible that if there may be beneficial effects, she speculated. "Could one use, for example, this type of technology to activate areas of the brain that may not be properly activated and explore potential therapeutic applications of this type of technology? But that would require that one show there are no untoward effects."

## **Add to the Concern**

In an editorial accompanying the publication, Henry Lai, PhD, from the Department of Bioengineering at the University of Washington, Seattle, and Lennart Hardell, MD, PhD, from the Department of Oncology at University Hospital, Orebro, Sweden, point out that this is the first investigation in humans of glucose metabolism in the brain after cell phone use.

"The results by Volkow et al add to the concern about possible acute and long-term health effects of radiofrequency emissions from wireless phones, including both mobile and cordless desktop phones," they write.

"Although the biological significance, if any, of increased glucose metabolism from acute cell phone exposure is unknown, the results warrant further investigation."

The effects are unlikely to be mediated by the substantial increase in temperature seen with cell phones given the activation was "quite distant" from where the cell phone made contact, they speculate. Further, since the subjects were only listening rather than talking on the phone, "the effect observed could thus potentially be more pronounced in normal-use situations."

The study was supported by the Intramural Research Program of the National Institutes of Health and by infrastructure support from the US Department of Energy. The researchers and editorialists have disclosed no relevant financial relationships.

JAMA. 2011;305:808-814, 828-829.