Summary

Nicotine dependence is a global health problem that causes many deaths worldwide. Although there are findings describing the effect of nicotine on the behavior of various animals, the molecular and neural mechanisms mediating the effects of nicotine in the short and long term are only beginning to become clear. Nicotine increases the activity of certain neurons by activating receptors, but the set of factors involved in the process, and the degree of importance of the sex on the potential for influence, have not yet been discovered.

This study examined the acute effects of nicotine administration on the speed of movement in C. elegans worms, a model organism with a fully known cell composition that is often used in neurology. Specifically, we aimed to investigate sex specificity and molecular mechanisms in nerve cells that allow for a behavioral phenotype in response to nicotine. We used the WT strain (him-5) and a mutant strain for the dopaminergic receptor Dop-R (dop-1). We examined the speed of movement as a parameter for evaluating the effects of nicotine.

In males but not in hermaphrodites, we found a significant difference in the movement speed between worms exposed to nicotine and those not exposed to it. These results are consistent with findings from past studies and confirm a difference in the mode of response and effects of nicotine between the sexes.

We found that the effects of acute nicotine exposure on movement speed that was found in the WT strain were eliminated in mutant males from the dop-1 strain. We hypothesize that in C. elegans, Dop-R receptors have a different role between the sexes and that the neural pathway mediates motor hyperactivity as a result of acute exposure to nicotine differs between the sexes. Furthermore, because C. elegans worms have almost no effect of sex hormones, these results suggest that these receptors play a crucial role in mediating the effects regardless of hormonal differences between the sexes.

In addition, dop-1 males were found to move faster than WT males regardless of nicotine exposure. Our results suggest that in the C. elegans model, the dopR receptor plays a key role in motility regulation in males regardless of nicotine exposure.