

Neural activity in response to smoking-related and neutral pictures in three different states in smokers compared to non-smoking controls

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Background

Tobacco smoking is the leading preventable cause of premature death worldwide and despite many smokers wanting to quit, relapse rates are high [1]. Cue-induced craving plays a prominent role in relapse of tobacco use disorder (TUD) [2]. Therefore, elucidating the underlying neural correlates may shed light on relapse mechanisms. Previous fMRI studies have found inconsistent results, due to different experimental paradigms and smoking states investigated [3].

Aim: Differentiate brain activity during a cue reactivity task between three different smoking states and towards non-smoking controls.

Methods

Fifty-one male smokers and fifty non-smoking matched controls underwent BOLD fMRI, with smokers measured in three smoking states: baseline, withdrawal and satiation. Smoking-related and neutral pictures were presented in a block design during fMRI. The BOLD response was compared between smoking-related and neutral pictures for each subject and state. Brain activation was compared across groups and states. Craving was rated on a visual analog scale and state-specific withdrawal symptoms and TUD severity were assessed. Associations were examined between cue-induced neural activity and craving, withdrawal symptoms and TUD severity.

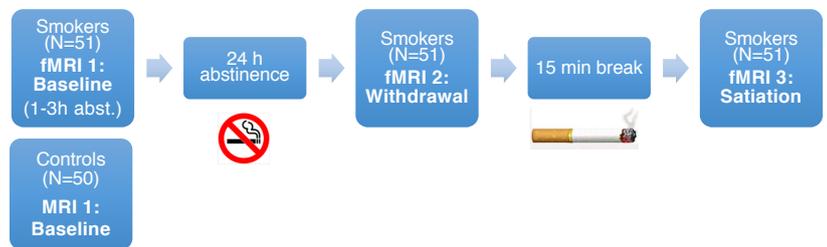


Figure 1: Study protocol

Results

In smokers, the BOLD response to smoking-related compared to neutral images was greater in the right occipital gyrus and left prefrontal cortex during baseline. During withdrawal, greater activation was found bilaterally in the occipital gyrus, left fusiform gyrus and right cuneus, prefrontal cortex and temporal gyrus. Compared to controls, smokers showed higher activity in the right frontal gyrus during satiation. TUD severity, withdrawal symptoms and craving at baseline were positively correlated with activity in the right occipital gyrus and left prefrontal cortex.

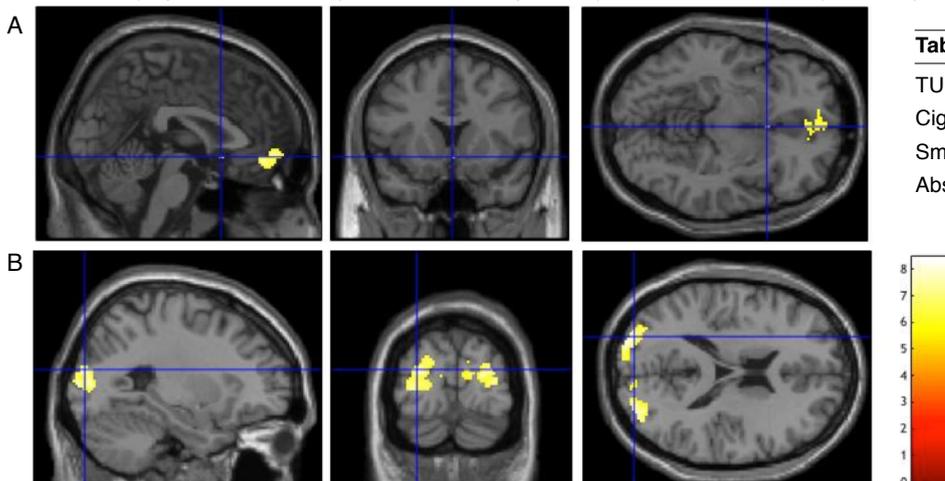


Table 2: Smoking characteristics (mean with SD)

TUD Severity (FTND sum)	4.26 (2.27)
Cigarettes per day	19.98 (4.55)
Smoking duration (years)	7.01 (5.07)
Abstinence (withdrawal, hours)	28.78 (5.24)

Figure 2: BOLD response during withdrawal was greater in the right prefrontal gyrus (A) and bilateral occipital gyrus (B).

Discussion

Compared to neutral pictures, smoking-related pictures elicited higher BOLD responses in visual processing areas during baseline and withdrawal in smokers, with prominent recruitment of the extended visual system during the latter state. Additionally, frontal brain areas involved in inhibitory control were activated. Interestingly, this response was not seen in the satiated state, however, premotor areas were found to elicit higher responses in this state compared to controls. Stronger TUD severity, craving and withdrawal symptoms were associated with higher activity in the same visual processing and inhibitory control areas. These results imply that more severe nicotine addiction is associated with stronger smoking cue reactivity.

References

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No conflicts of interest declared.

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