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Neural Differences Between Smokers & Non-Smokers Responses to Pictorial Health Warnings: An Electroencephalography Study

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Abstract. Indonesia continues to exhibit one of the highest smoking rates globally despite more than a decade of mandatory pictorial health warning implementation to regulate cigarette sales. While previous research has largely relied on self-reported measures, little remains known regarding whether repeated exposure to cigarette warnings alters the underlying neural processing of these images, particularly within highly normalized smoking environments such as Indonesia. The present study investigated attentional and emotional neural responses toward pictorial health warnings among smokers and non-smokers using electroencephalography. Building on previous Western findings and theories of defensive avoidance, it was hypothesized that smokers would demonstrate preserved early attentional processing but diminished emotional engagement toward warning images. A total of 40 participants consisting of smokers and non-smokers completed an experimental oddball and passive-viewing paradigm while electroencephalography activity was recorded. Neural processing was examined through the event-related potential components P3, reflecting attentional allocation toward task-relevant stimuli, and the Late Positive Potential, reflecting sustained emotional engagement. Results demonstrated comparable P3 responses between smokers and non-smokers, indicating preserved early attentional processing toward warning images across groups. Contrary to expectations, the sample of Indonesian smokers also exhibited preserved Late Positive Potential responses toward warning images despite chronic environmental exposure to cigarette-related cues. Additional findings further indicate limited gender-modulated neural differences among participants. Findings suggest that repeated exposure to warning images within the Indonesian context have not resulted in substantial neural desensitization, therefore highlighting the importance of sociocultural context in shaping effective tobacco control strategies.

Keywords: *Electroencephalography (EEG); Event-Related Potentials (ERP); Neural Responses; Pictorial Health Warnings (PHWs); Smoking Behavior*

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Abstrak. Prevalensi merokok di Indonesia tetap berada pada tingkat yang mengkhawatirkan secara global, meskipun regulasi peringatan kesehatan bergambar pada kemasan rokok telah diterapkan selama lebih dari satu dekade. Sebagian besar studi terdahulu banyak mengandalkan metode *self-report* tradisional dan belum secara menyeluruh mengkaji terkait pemrosesan neural yang mendasari respons terhadap gambar peringatan kesehatan, khususnya dalam konteks budaya merokok yang sangat ternormalisasi seperti di Indonesia. Penelitian ini menyelidiki respons neural atensional dan emosional terhadap peringatan kesehatan bergambar pada kelompok perokok dan nonperokok menggunakan elektroensefalografi. Berlandaskan teori *defensive avoidance*, penelitian ini menghipotesiskan bahwa perokok akan menunjukkan pemrosesan atensi awal yang tetap terjaga, tetapi keterlibatan emosional yang menurun terhadap gambar peringatan kesehatan. Sebanyak 40 partisipan yang terdiri atas perokok dan nonperokok berpartisipasi dalam tugas eksperimental *oddball* dan *passive viewing* untuk mengukur respons neural menggunakan elektroensefalografi. Analisis difokuskan pada komponen *event-related potential* P3 yang merefleksikan pemrosesan atensi awal terhadap stimulus target, serta *Late Positive Potential* yang merefleksikan keterlibatan emosional. Hasil penelitian menunjukkan bahwa perokok dan nonperokok sama-sama memperlihatkan peningkatan respons P3 terhadap gambar peringatan, yang mengindikasikan bahwa kedua kelompok sama-sama memberikan atensi yang cukup terhadap gambar peringatan kesehatan. Menyanggah dugaan awal, perokok ternyata menunjukkan respons Late Positive Potential yang juga tetap terjaga terhadap gambar peringatan kesehatan meskipun telah banyak terpapar gambar peringatan rokok dalam kehidupan sehari-hari. Analisis eksploratori turut menunjukkan perbedaan respons neural yang dipengaruhi gender. Temuan studi ini menunjukkan bahwa paparan berulang terhadap peringatan kesehatan bergambar dalam konteks Indonesia tidak secara otomatis menyebabkan desensitisasi neural emosional terhadap pesan kesehatan. Temuan ini juga menyoroti pentingnya mempertimbangkan konteks sosiokultural dalam memahami efektivitas regulasi pengendalian tembakau di masyarakat.

Keywords: *Elektroensefalografi (EEG); Event-Related Potentials (ERP); Respons Neural; Peringatan Kesehatan Bergambar; Perilaku Merokok*