

## A systematic review and meta-analysis of the relationship between smoking and intelligence measures

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**Introduction:** It is unclear if smoking influences cognitive/ intellectual abilities, assessed by intelligence quotient (IQ) test scores. In this study, we systematically reviewed and synthesize results of studies concerning the association between tobacco smoking and IQ.

**Method:** We systematically searched PubMed, Embase, Scopus, Web of Science and PsycINFO and employed an AI research tool to conduct additional search for publications on the association between tobacco smoking (including second-hand exposure) and IQ, published up to 23 April 2022. Data on study details, measurement of smoking and measurement of IQ were extracted from each article. Quality was assessed using the Newcastle-Ottawa Quality Assessment Scale. A meta-analysis using a random effects model was also conducted.

**Results:** A total of 15 publications (out of 1,030 identified) were included. The studies had low appraisal scores (average of 5.5 over 10). Eleven cross-sectional papers concerned young adults, adolescents and children. Among three studies that focused on second-hand smoke, two reported significant negative influence of second-hand smoking on IQ. Meta-analysis of four methodologically comparable cross-sectional studies found a significant association between smoking and lower IQ (pooled mean difference = 4.79, 95% CI:3.11 - 6.48,  $I^2 = 47.7\%$ ). Findings were robust to sensitivity analyses. Four longitudinal studies concerned older adult populations (aged 64 to 80). All found significantly lower IQ scores among people who currently smoke.

**Discussions and Conclusions:** We found a modest association between tobacco smoking and lower IQ, when measured though standardised testing. Further studies are warranted to investigate suggestive evidence of cognitive recovery after quitting smoking and to explore whether the difference is explained by residual confounding or reflects adverse cognitive effects of cigarette smoking.

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