Contributors NAA conceived the study idea and is PI of the SLOPE (Studying Lifecourse Obesity PreEdictors) study. NZ cleaned and managed the raw data. EJT analysed the data. EJT drafted the abstract. All authors contributed to the study design, interpreted the results, revised the abstract for content and approved the final version before submission.

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Background Smoking remains a top public health priority, killing over 6m people annually. Planning future tobacco control policies can greatly benefit from population prediction models for tobacco use (mathematical models that simulate tobacco exposure and its health impact in the population). Those models were mainly developed to project trends and simulate policy as identified in a systematic review published in 2013. Common outcomes were changes in tobacco use behaviour, tobacco-related morbidity/mortality, and economic impact. We updated, expanded and enhanced the 2013 review. We aimed to identify best modelling practices, highlight common pitfalls, and develop a quality-assessment checklist.

Methods We systematically searched PubMed, Embase, CINAHL Plus, EconLit, and PsycINFO for publications between July 2013 and August 2019 using the search strategy of the 2013 review. We included studies referring to tobacco product or tobacco use and projected a tobacco-related outcome. We only included studies in English. Two reviewers independently assessed the eligibility of the identified studies through title and abstract screening followed by full-text review; all discrepancies were resolved in consensus with a third reviewer. We designed and piloted a data-extraction form based on existing guidelines to collect information such as model structure, data sources and transparency. We analysed the evidence using narrative synthesis. We developed a quality-assessment checklist for population prediction tobacco models, including the risk of bias and standard quality criteria.

Results In total, 5046 records were identified of which 830 were duplicates; 80 papers were included in this review. A diverse range of modelling/simulation methodologies, including microsimulations, decision-trees, and agent-based models have been used in population tobacco use prediction modelling. However, methodological transparency was notably lacking. Furthermore, the tobacco modelling community apparently works mostly in ‘silos’, hindering the diffusion of good modelling practice, and promoting wasteful repetition of effort. For example, while some models appropriately simulate smoking intensity and duration to model cumulative hazard, others only simulate smoking status (i.e. never/ever/current).

Conversely, the modelling teams participating in the Cancer Intervention and Surveillance Modelling Network (CISNET) collaborated well, sharing data, methodological advancements and ‘building blocks’ for their models.

Worryingly, some tobacco models received industry funding, making bias likely.

Conclusion Population prediction modelling for tobacco use is an active area of research. However, our systematic methodological review identified variable quality and an overall lack of transparency. More active collaboration using transparent methods and open-source code could avoid wasteful duplication of effort, speed scientific progress and benefit both the tobacco control community and wider society.