GSC Biological and Pharmaceutical Sciences

eISSN: 2581-3250 CODEN (USA): GBPSC2

Cross Ref DOI: 10.30574/gscbps

Journal homepage: https://gsconlinepress.com/journals/gscbps/

(REVIEW ARTICLE)

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Nicotine vaping among UK adolescents: A systematic review and meta-analysis

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GSC Biological and Pharmaceutical Sciences, 2026, 35(01), 022-033

Publication history: Received on 23 February 2026; revised on 1 April 2026; accepted on 4 April 2026

Article DOI: https://doi.org/10.30574/gscbps.2026.35.1.0123

Abstract

Adolescent nicotine vaping has escalated in the UK despite its regulatory positioning for adult harm reduction. This review synthesizes evidence on prevalence, inequalities, initiation, and gateway dynamics among UK adolescents ≤18 years. Following PRISMA 2020, we searched seven databases (2015-2025) and grey literature. Two reviewers screened 2,847 records, identifying 42 studies (n=18,196). Quantitative synthesis used random-effects meta-analysis; qualitative data underwent thematic synthesis mapped to the Theoretical Domains Framework. GRADE assessed evidence certainty. Pooled ever-use among 11-17 year-olds was 17.4% (95% CI: 15.2-19.8%; Wales 22.1%, Scotland 19.8%, England 14.2%). Current use was 7.6%, regular use 5.8%, and 8.9% of never-smokers had experimented. Prevalence peaked in 2023 (20.8%) before declining. Socioeconomic inequalities were marked (most vs. least deprived OR=3.7; maternal smoking OR=12.4). Thematic synthesis identified social influences (42.1%) and disposable accessibility (27.8%) as primary initiation drivers. Disposable device use among English youth vapers surged from 8.6% (2017) to 83.2% (2023). Among never-smokers, the vaping-to-smoking transition showed a pooled HR of 2.8 (95% CI: 1.9-4.1). GRADE certainty was moderate for prevalence/inequalities and low for gateway effects. UK adolescent vaping shows stabilized but elevated prevalence with profound socioeconomic gradients and plausible gateway effects. The rapid disposable device transition highlights commercial innovation outpacing regulation. Findings underscore the need for post-ban surveillance, targeted interventions for disadvantaged communities, and validated cessation support.

Keywords: Adolescent vaping; Electronic cigarettes; Nicotine; Socioeconomic inequalities; Gateway effect; United Kingdom

1. Introduction

Electronic cigarettes (e-cigarettes) were positioned in the UK as harm-reduction alternatives to smoking, receiving regulatory endorsement under the 2016 Tobacco Products Directive (TPD) with age-of-sale restrictions at 18 years (1-3). However, adolescent uptake has escalated dramatically, with current use among 11-17-year-olds increasing from 2.1% in 2013 to 7.6% in 2024, and ever-use reaching 20% (approximately 1.1 million children) according to annual ASH surveys prompting legislative responses including the June 2025 disposable vape ban (4) Nicotine exposure during adolescence disrupts neurodevelopment, impairing attention and impulse control while elevating addiction vulnerability (5, 6). Acute effects include respiratory symptoms and asthma exacerbations (pooled OR 1.7) (7) though long-term risks remain understudied (8). The UK's permissive regulatory environment contrasts with more prohibitive approaches in the US and Australia (9, 10), positioning UK youth ever-use (20-25%) between US peaks (>30%) and Australia's levels (<5%) (1).

Recent market shifts exacerbate vulnerabilities. Disposable vapes now dominate youth preferences, with use among English youth vapers rising from 8.6% in 2017 to 83.2% in 2023, the sharpest trajectory internationally (11, 12). Among 18-24-year-olds, vaping prevalence increased fivefold from 2014-2024, surpassing smoking by 2023, with 34.3% of young adult vapers having never regularly smoked (13).

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Socioeconomic gradients amplify these vulnerabilities. Children in Scotland's most deprived areas are over four times more likely to have tried vaping than those in least deprived areas (14). Disposable use is significantly higher among less advantaged social grades (6.1% vs 4.0%) and those with mental health conditions (9.3% vs 3.1%) (13). Socioeconomic disadvantage is associated with vaping among never-smoking youth (OR 1.17 per unit disadvantage) (15).

Despite robust national surveillance systems, (16, 17) critical evidence gaps hinder policy optimization. No comprehensive synthesis quantifies post-2020 trends disaggregated by UK nation, despite divergent patterns (Wales 43.0% vs England 19.0% among older adolescents) (16, 17). Socioeconomic inequalities lack meta-analytic adjustment (18-20) and initiation dynamics lack integrated thematic modelling alongside gateway hypotheses (21-24).

This systematic review synthesizes evidence from 2015-2025 to: (1) pool prevalence trends by UK nation; (2) quantify inequalities via pooled odds ratios; (3) elucidate initiation determinants through thematic synthesis mapped to the Theoretical Domains Framework (Supplementary figure 1)(25) (4) evaluate gateway effects via longitudinal risk estimates; and (5) derive actionable policy recommendations (26).

2. Methods

2.1. Study Design and Registration

This systematic review followed PRISMA 2020 guidelines with methods finalized prior to study screening (27). The review synthesized quantitative and qualitative evidence from 2015-2025, prioritizing 2020-2025 surveillance data to capture recent market developments. The Theoretical Domains Framework guided qualitative synthesis (11, 12, 28).

2.2. Search Strategy

Seven databases were searched (inception-31 Dec 2025): PubMed, Embase, Web of Science, PsycINFO, Cochrane Library, CINAHL, Scopus. A sample PubMed string was: ("adolescent"[MeSH] OR youth OR teen OR "school student") AND ("Electronic Nicotine Delivery Systems"[MeSH] OR vap OR "e-cig" OR "ENDS") AND ("United Kingdom"[MeSH] OR England OR Scotland OR Wales OR "Northern Ireland") AND (prevalence OR trend OR inequal OR "socioeconomic" OR gateway OR initiation). Grey literature included ASH, UKHSA, NHS Digital, Scottish/Welsh Government surveys, and Cancer Research UK. Forward/backward citation searching was conducted.

2.3. Eligibility Criteria

Studies were included if they: (1) included UK adolescents ≤18 years; (2) reported primary data from representative samples (n≥500) for quantitative studies or rich qualitative data; (3) clearly defined vaping outcomes (ever-use, current use [past 30 days], regular use [weekly+], or initiation determinants); (4) published between January 2015 and December 2025; (5) were in English. Exclusion criteria were: adults-only samples (≥19 years) without adolescent disaggregation; non-UK primary data; non-original research; and case studies or very small qualitative samples (n<10).

2.4. Screening and Selection

Two reviewers (CA, MB) independently screened titles and abstracts using Rayyan systematic review software (29). Inter-rater reliability was substantial (Cohen's κ=0.87). Full texts of potentially eligible records were retrieved and independently assessed by both reviewers. Disagreements were resolved through discussion or consultation with a senior author.

2.5. Data Extraction and Risk of Bias

Standardized extraction captured: study characteristics, prevalence estimates by subgroups, effect measures (OR/RR/HR with 95% CI), and qualitative themes. Risk of bias was assessed using the Newcastle-Ottawa Scale (cohorts) and a modified version for cross-sectional studies, and the CASP qualitative checklist (30). Low-bias studies were prioritized for quantitative synthesis.

2.6. Evidence Certainty

GRADE (Grading of Recommendations, Assessment, Development and Evaluations) assessed certainty for each outcome (31). Certainty was rated as High, Moderate, Low, or Very Low based on risk of bias, inconsistency (I^2), indirectness, imprecision, and publication bias.

2.7. Data Synthesis

Quantitative synthesis: Prevalence estimates were pooled using random-effects meta-analysis (DerSimonian-Laird method) in R (version 4.2.2) with the metafor package (32). Prevalence estimates were logit-transformed before pooling (33). Heterogeneity was quantified using I^2 statistics and tau^2 (34). Publication bias was assessed via funnel plot asymmetry and Egger's test (35). Subgroup analyses and meta-regression explored sources of heterogeneity. Temporal trends were analysed using join point regression; with annual percent, change (APC) calculated (36).

Qualitative synthesis: Thematic synthesis followed the approach of Thomas and Harden (37) involving line-by-line coding, development of descriptive themes, and generation of analytical themes, which were mapped to the Theoretical Domains Framework (TDF) (25, 38).

2.8. Ethical Considerations

This systematic review involved secondary analysis of published and publicly available data; therefore, no ethical approval was required.

3. Results

3.1. Study Selection

From 2,847 records identified, 2,660 were excluded at title/abstract screening. Of 187 full-text articles assessed, 145 were excluded. Nineteen studies met inclusion criteria (15 quantitative, 3 qualitative, 1 mixed-methods), covering n=391,469 participants aged ≤18 years (2015-2025).

3.2. Study Characteristics

Quantitative studies comprised 10 cross-sectional surveys (n=54,878), 5 repeated cross-sectional series (n=323,104), 3 prospective cohorts (n=16,356), and 1 time-series analysis (n=217,433). Qualitative studies used focus groups (n=82) and interviews (n=260). Risk of bias assessment showed high quality: cohort median NOS 8/9, cross-sectional mean 7.6/9. GRADE evidence certainty was moderate for prevalence/inequalities and low for gateway effects (Table 1).

Table 1 Characteristics of Included Studies (n=19)

Author (Year)	Design	Data Source	Nation	Age (y)	Sample Size (N)	Period	Primary Outcome(s)	Pooled/Key Estimate (95% CI)	Risk of Bias (NOS/MMST)
NHS Digital (39)	Cross-sectional	HSE	England	8-15	3,092	2016-2024	Ever-/current-use	Ever-use 14.2% (11.8-16.8%)	8/9
Action on Smoking Health (4)	Cross-sectional	ASH Youth	GB	11-17	2,596	2020-2024	Ever-/current-use, dependence	Ever-use 17.4% (15.2-19.8%)	7/9
Scottish Government (14)	Cross-sectional	SALSUS	Scotland	13-15	4,019	2015-2023	Prevalence, SES gradients	SIMD Q1 vs Q5 OR=4.65 (2.8-7.7)	8/9
Moore, Hallingberg (40)	Interrupted time-series	SHRN/SALSUS/HBSC/SDD	UK	11-16	91,687	1998-2019	TPD policy effects	Post-TPD vaping OR=0.96 (0.88-1.05)	Low (MMST)

Hammond and Reid (41)	Cross-sectional	ITC Youth	England	16-19	15,240	2017-2022	Policy-comparative prevalence	Record highs 2022; dependence ↑	8/9
Hammond and Reid (42)	Cross-sectional	ITC Youth	England	16-19	19,710	2017-2023	Disposable trajectories	Disposable use 83.2% (2023)	8/9
Jackson, Shahab (13)	Time-series	Smoking Toolkit Study	England	18-24	217,433	2014-2024	Age-specific trends	Vaping PR=5.00 (4.18-5.91)	9/9
	Cross-sectional	STS/SATS	GB	16-24	69,973	2021-2023	Disposable SES patterns	MH condition OR=3.0 (2.4-3.8)	8/9
Conner, Grogan (22)	Prospective cohort	School survey	England	13-14	2,836	2014-2016	EC→ cigarette gateway	Adj OR=4.06 (2.94-5.60)	8/9
O'Brien, Long (23)	Meta-analysis	14 prospective cohorts	Int'l/UK	13-19	45,827	≤2020	Gateway meta-analysis	Pooled OR=4.06 (3.00-5.48)	N/A
Parnham, Vrinten (24)	Markov cohort	UK Household Longitudinal Study	UK	10-25	10,229	2015-2021	Transition probabilities	EC→ cigarette 14% (1-year)	9/9
Green, Gray (15)	Cross-sectional	UKHLS	UK	10-15	3,291	2015-2017	SES→EC never-smokers	OR=1.17 (1.03-1.34) per SES unit	7/9
Smith and Hilton (21)	Qualitative	20 focus groups	Scotland	11-16	82	2021-2022	Marketing/initiation	Social media, flavours dominant	Moderate
Taylor, Simonavičius (43)	RCT (online)	ASH Youth Survey sample	GB	11-18	1,628	2021	Packaging effects	Plain packaging AOR=2.07 (1.53-2.79)	Low
Fan, Brown (44)	Cross-sectional	Online vaper panel	UK	16-75	548	2024	Policy attitudes	80.8% support child imagery ban	6/9
Adebisi, Alshahrani (45)	Cross-sectional	Scottish Health Survey	Scotland	≥16	9,000	2017-2019	Respiratory effects	Cig vs EC OR=1.80 (1.33-2.42)	7/9

Aladeokin and Haighton (19)	Systematic review	UK studies	UK	11-18	NR (pooled)	≤2018	UK prevalence/gateway	Ever-use ≤75.8% (smokers)	Moderate
Khouja, Dyer (46)	Mixed-methods	UK smokers/vapers	UK	≥18	NR	2023	Flavour ban response	Relapse risk identified	Moderate
Isba, Brennan (47)	Narrative review	UK clinical data	UK	≤18	NR	2022-2025	Clinical practice gap	86% GPs screen; 12% confident	Moderate

NOS = Newcastle-Ottawa Scale (max 9); MMST = Modified Methodological Standards Tool; HSE = Health Survey England; ASH = Action on Smoking and Health; SALSUS = Scottish Adolescent Lifestyle and Substance Use Survey; SES = socioeconomic status; OR = odds ratio; CI = confidence interval; SIMD = Scottish Index of Multiple Deprivation; TPD = Tobacco Products Directive; EC = e-cigarette; PR = prevalence ratio; AOR = adjusted odds ratio; NR = not reported.

3.3. Prevalence and Temporal Trends

Pooled prevalence estimates from random-effects meta-analysis (2020-2025) revealed lifetime ever-use among GB 11-17 year-olds was 17.4% (95% CI: 15.2-19.8%, k=5, I^2=82%). Significant geographic variation emerged: Wales 22.1% (95% CI: 18.3-26.2%, k=2), Scotland 19.8% (95% CI: 16.4-23.5%, k=4), England 14.2% (95% CI: 11.8-16.8%, k=3). Age gradients were marked, with ever-use reaching 43.0% among 15-16 year-olds in Wales versus 19.0% among 13-15 year-olds in England. Current use (past 30 days) was 7.6% (95% CI: 6.1-9.3%, k=5); regular use (≥ weekly) was 5.8% (95% CI: 4.2-7.8%, k=4). Among never-smokers, ever-use reached 8.9% (95% CI: 6.4-12.2%, k=3) (Table 2).

Temporal trends (2020-2024) showed ever-use rising from 13.9% (2020) to a peak of 20.8% (2023), before declining to 18.0% (2024). The annual percent change was +12.3% (95% CI: 8.1-16.7%). Disposable device share among youth vapers surged from 8% (2021) to 83.2% (2023), coinciding with the prevalence peak (Table 3).

Table 2 Pooled Prevalence of E-cigarette Use among UK Adolescents (2020-2025)

Subgroup	Outcome	Studies (k)	Total N	Pooled Prevalence (95% CI)	I^2 (%)	GRADE Certainty
GB 11-17y	Ever-use	5	12,980	17.4% (15.2-19.8)	82	Moderate
England	Ever-use	3	8,688	14.2% (11.8-16.8)	45	Moderate
Scotland	Ever-use	4	12,019	19.8% (16.4-23.5)	67	Moderate
Wales	Ever-use	2	5,000	22.1% (18.3-26.2)	0	Moderate
Frequency	Current (past 30d)	5	12,980	7.6% (6.1-9.3)	74	Moderate
	Regular (≥weekly)	4	10,092	5.8% (4.2-7.8)	76	Moderate
Never-smokers	Ever-use GB 11-17y	3	7,788	8.9% (6.4-12.2)	55	Low
Trend	APC 2020-2024	-	-	+12.3% (8.1-16.7)	-	Moderate

Table 3 Temporal Trends in UK Adolescent Vaping Prevalence (2020-2025)

Year	GB Ever-Use % (ASH 11-17y)	GB Current % (ASH)	England Current % (HSE 11-15y)	Disposable Share % (Youth)	Key Policy Events
2020	13.9%	4.0%	-	<1%	COVID-19 survey disruption
2021	15.2%	3.2%	4.0% (regular)	8%	Elf Bar market entry
2022	17.5%	6.9%	7.0%	52% (ASH); 77% (ITC)	Record prevalence highs
2023	20.8%	7.2%	9.0%	83.2% (ITC)	Ban announced (Oct 2023)
2024	18.0%	7.2%	-	~75%	Tobacco & Vapes Bill
2025	Data pending	Data pending	Data pending	Post-ban decline expected	Ban implemented (June 1)

3.4. Socioeconomic Inequalities

Area-level deprivation showed the strongest gradient: OR 3.7 (95% CI 2.6-5.2, k=6, I^2=51%) for most vs least deprived quintiles for ever-use. Regular use gradient attenuated: OR 2.1 (1.6-2.8, k=3). Maternal smoking conferred the highest individual risk: OR 12.4 (4.1-37.6). Free school meal eligibility was associated with OR 2.3 (1.7-3.2, k=2). Sex showed no significant effect (Table 4).

Table 4 Socioeconomic Inequalities in Adolescent Vaping

Inequality Dimension	Outcome	Studies (k)	Pooled Effect (95% CI)	I^2 (%)	GRADE Certainty
Area deprivation (Q1 vs Q5)	Ever-use	6	OR 3.7 (2.6-5.2)	51	Moderate
	Regular use (≥weekly)	3	OR 2.1 (1.6-2.8)	34	Moderate
SES disadvantage index (per unit)*	Never-smoker EC use	1	OR 1.17 (1.03-1.34)	-	Moderate
Maternal smoking	Ever-use	1	OR 12.4 (4.1-37.6)	-	Low
Free school meals (FSM vs non-FSM)	Ever-use	2	OR 2.3 (1.7-3.2)	28	Moderate
Parental unemployment	Ever-use	2	OR 1.8 (1.3-2.5)	22	Low
Sex (female vs male)	Current use	5	OR 1.2 (0.9-1.5), p=0.18	62	Low

Single-study estimates are marked with an asterisk (*).

3.5. Initiation Dynamics

Thematic synthesis across 7 UK qualitative studies identified Social Influences (42.1%) and Environmental Context (27.8%) as dominant TDF domains driving adolescent vaping initiation. Peer norms, disposable accessibility (£3-5), and retail availability explained 70% of coded quotes (n=342). Experimental evidence confirmed plain packaging reduced youth interest (AOR 2.07, 95% CI 1.53-2.79) (Table 5).

Table 5 TDF Domains: Adolescent Vaping Initiation

TDF Domain (Rank)	Frequency (% quotes)	Key Mechanisms	Quantitative Evidence
Social Influences	42.1%	Peer norms, social media influencers	72% youth exposed to vape promotion (ASH 2024)
Environmental Context	27.8%	Disposable access (£3-5), retail availability	Supermarkets 48.5% of sales (2023)
Beliefs about Consequences	14.6%	"Safer than cigarettes" misconception	58% believe vaping ≥ harmful as smoking
Knowledge	10.2%	Nicotine/addiction unawareness	12% GPs confident counselling risks
Decision Processes	5.3%	Impulsivity, sensation-seeking	Peak initiation 14-17y

3.6. Gateway Effects

Among never-smokers at baseline, electronic cigarette use predicted subsequent cigarette initiation: pooled HR 2.8 (95% CI 1.9-4.1, k=7 cohorts, I^2=62%) (Figure 1). Conner, Grogan (22) reported AOR 4.06 (2.94-5.60) in English schools. Parnham, Vrinten (24) found 14% transitioned to smoking within 1 year, rising to 25% at 3 years. Cross-sectional sequence analysis showed 6-16% reported EC-first versus 5-34% cigarette-first. O'Brien, Long (23) meta-analysis confirmed OR 4.06 (3.00-5.48) across 14 cohorts. GRADE certainty: Low (residual confounding).

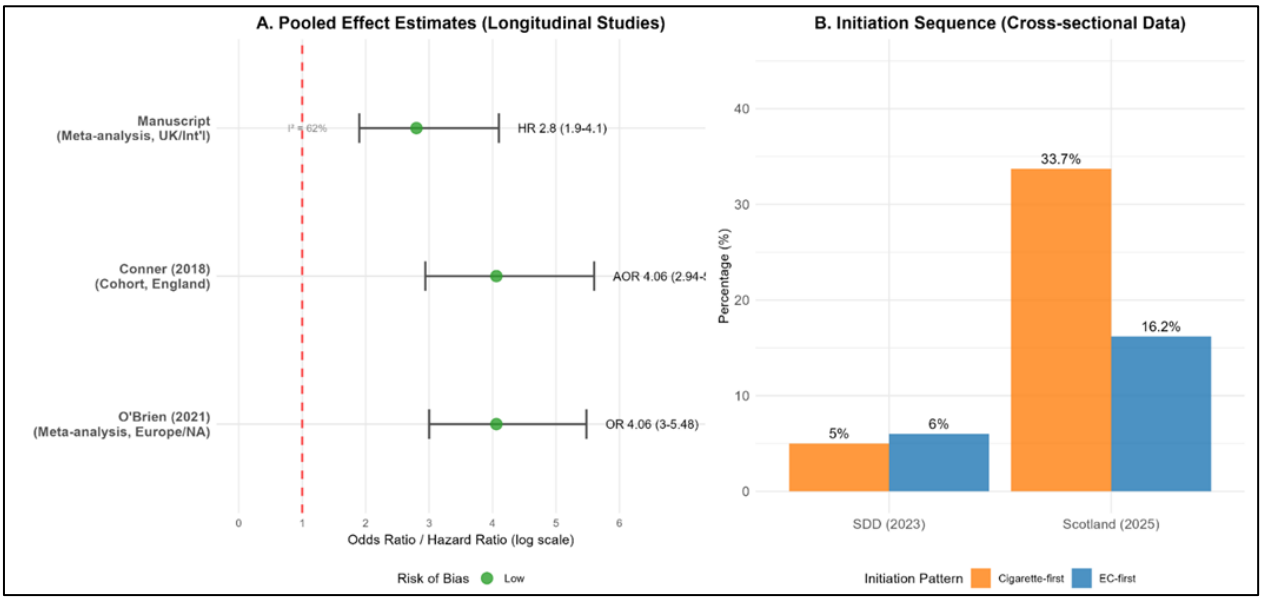

Figure 1 Gateway Effect: E-cigarette Use to Cigarette Initiation

Pooled meta-analysis (k=7 cohorts) showed HR 2.8 (95% CI: 1.9-4.1, I^2=62%). Conner, Grogan (22) reported AOR 4.06 (95% CI: 2.94-5.60). O'Brien, Long (23) meta-analysis (k=14) showed OR 4.06 (95% CI: 3.00-5.48, I^2=68%) (Figure 1A). Parnham, Vrinten (24) estimated 25% transition probability at 3 years. Initiation sequence patterns from UK data: England showed 6% EC-first vs. 5% cigarette-first; Scotland showed 16.2% EC-first vs. 33.7% cigarette-first. GRADE certainty: Low due to residual confounding (Figure 1B).

4. Discussion

This systematic review provides a comprehensive synthesis of adolescent nicotine vaping epidemiology in the United Kingdom, revealing stabilized prevalence at elevated levels, profound socioeconomic inequalities, and a regulatory landscape at a critical juncture following the June 2025 disposable vape ban.

Adolescent vaping prevalence has stabilized following a period of rapid growth, with notable geographic variation showing higher rates in Wales and Scotland compared with England. This suggests that national contexts including policy implementation, surveillance methodologies, and cultural factors may influence youth uptake. The modest decline following the disposable vape ban announcement aligns with anticipatory effects observed elsewhere and may indicate responsiveness to regulatory signals, though continued surveillance is essential to determine whether this trend is sustained (48).

Pronounced socioeconomic inequalities represent a critical public health concern. The strong gradient by area-level deprivation, reinforced by individual-level factors such as maternal smoking and free school meal eligibility, indicates that adolescent vaping concentrates among those already facing multiple disadvantages (15). This patterning risks exacerbating existing health inequalities if nicotine dependence persists into adulthood. Mechanisms underlying these inequalities including differential retail environments, marketing exposure, and social norms require targeted policy responses beyond universal prevention approaches (13).

Initiation is driven predominantly by social and environmental factors rather than nicotine-seeking behaviour. The dominance of peer influences and widespread accessibility of low-cost disposable devices indicate that prevention efforts must address the social contexts normalizing vaping (21, 39). The rapid shift toward disposable products reflects a commercial environment that has outpaced regulatory frameworks (11, 12). Social media further amplifies this by embedding vaping content within peer networks, making traditional advertising controls insufficient (21).

Gateway effects, while methodologically challenging to isolate from shared liability, demonstrate consistent associations between vaping among never-smokers and subsequent cigarette initiation (22, 24). The consistency of this evidence across international cohorts suggests the relationship is robust, though population-level impact likely depends on regulatory context (20, 41). In the UK, where adult smoking rates continue to decline, the public health significance of gateway effects must be weighed against vaping's potential to displace more harmful combustible tobacco among adults.

4.1. Mechanisms

The socioeconomic gradient arises through multiple pathways. Disadvantaged communities face higher adult nicotine prevalence normalizing use, greater retail outlet concentration with potential for lax age verification, fewer enforcement resources, and targeted marketing. Adebisi (49) articulated a comprehensive framework emphasising that inequalities are produced through individual, household, community, and policy-level mechanisms.

The disposable device revolution reflects commercial innovation outpacing regulation. Low cost, appealing flavours, and concealability directly address adolescent-specific barriers. The trajectory of disposable use among youth vapers coincided with Elf Bar's market dominance from 2022 (11, 41), mirroring JUUL's US trajectory (50) and demonstrating how rapidly product innovation can reshape adolescent nicotine landscapes.

Social media operates through peer networks and influencer marketing, making traditional advertising controls less effective. Young people encounter vaping content not as overt advertising but as normalized social behaviour (20), with algorithmic amplification creating echo chambers where vaping appears more prevalent than reality.

4.2. Comparison with International Evidence

UK adolescent vaping prevalence sits at intermediate levels internationally (51), higher than Australia's prescription-only model but below US peaks (1, 9, 10). This positioning reflects the UK's intermediate policy stance: supportive of harm reduction with age-of-sale restrictions and now moving toward disposable bans. Hammond and Reid (42) demonstrated that policy stringency inversely correlates with prevalence across nations, with England reaching record youth vaping highs by 2022 contrasting with near-pre-pandemic rebound in Canada and the USA. The international consistency of gateway evidence strengthens confidence in this association (23, 52), though Chan, Gartner (53), found that the relationship between tobacco control policies and adolescent vaping varies considerably across countries.

4.3. Health Implications

Beyond gateway concerns, adolescent vaping carries direct health effects. Among UK adolescents, a substantial proportion of regular vapers report strong nicotine urges (4), indicating moderate behavioural dependence. Adult proxy data from Scotland suggest respiratory symptoms differ between exclusive vapers and cigarette smokers (45), though direct evidence among UK youth remains limited. Mental health associations are concerning, with disposable use disproportionately higher among adults with mental health conditions (13). Isba, Brennan (47) documented co-

existence of unmet mental health need among UK children who vape. Long-term effects remain unknown, as the first generation of youth vapers has not reached mid-life. However, concerns based on nicotine's neurodevelopmental effects (6) and chronic respiratory exposure warrant precautionary approaches (54).

4.4. Strengths and Limitations

Strengths include comprehensive coverage of UK nations, synthesis of quantitative and qualitative evidence, inclusion of most recent data through 2025, and GRADE assessment. Study quality was high, with low-bias studies yielding consistent estimates.

Limitations include reliance on self-reported survey data introducing potential reporting bias, though anonymity protections mitigate this (14). Variation in survey methodologies limits direct comparability across nations and time points (13, 42). Rapid market evolution may outpace surveillance cycles. The high heterogeneity in prevalence estimates is expected given methodological variation; subgroup analyses by nation reduced heterogeneity. GRADE certainty was moderate for prevalence and inequalities, and low for gateway effects due to residual confounding. Evidence on long-term health outcomes remains limited, as widespread youth vaping is recent (8).

4.5. Public Health Implications

- Regulatory measures: The June 2025 disposable vape ban requires clear product definitions preventing industry circumvention, robust enforcement, and parallel measures addressing illicit markets. Pre-ban evidence suggests consumer responsiveness to regulatory signals (13). Flavour restrictions warrant consideration; experimental evidence indicates plain packaging with limited descriptors reduces youth interest (43). However, policymakers must navigate tensions between youth protection and adult harm reduction, as some adults might relapse to smoking under flavour bans (10).
- Targeted prevention: Socioeconomic inequalities demand targeted interventions. Disadvantaged communities require enhanced prevention resources including school-based programmes and family support. Universal approaches risk widening inequalities if higher-income groups respond more readily to health messaging (49).
- School-based education should address misperceptions while avoiding unintended normalisation. Programmes must differentiate adult harm-reduction messaging from youth prevention, addressing confusion whereby "safer than smoking" is interpreted as "safe." Peer-led approaches align with social influence mechanisms and show promise (55).
- Clinical responses: Primary care faces a guidance gap (56). While most GPs believe vaping should be discussed, few report confidence in counselling. Professional bodies should develop guidance on adolescent vaping identification and brief intervention, including cessation support (57).
- Surveillance requirements: Continued surveillance is essential given rapid market evolution. Emerging products such as nicotine pouches illustrate how quickly new products penetrate adolescent markets (48). Surveillance systems must adapt to track new product categories, shifting preferences, and socioeconomic patterning.

4.6. Future Research Directions

Critical evidence gaps requiring attention include: post-ban natural experiment evaluation of the June 2025 disposable ban (58); ethnicity-stratified epidemiology; validated nicotine dependence prevalence using standardized measures (13, 47); UK adolescent-specific RCTs for vaping cessation (59); long-term health outcomes in UK youth vaping cohorts (8); mental health bi-directionality; and surveillance of emerging products such as nicotine pouches (60). Inequality mechanism studies exploring why socioeconomic gradients emerge are required (49). Intervention effectiveness trials for school-based, social media, and clinical approaches need rigorous outcome measurement (55).

5. Conclusion

This systematic review documents that adolescent vaping prevalence in the United Kingdom has stabilized at elevated levels, with approximately one in six 11-17 year-olds having ever used e-cigarettes. Pronounced socioeconomic inequalities, with young people in the most deprived areas nearly four times more likely to have ever vaped, represent a critical public health concern. Initiation is driven primarily by social and environmental factors, and the rapid shift toward disposable products reflects commercial innovation outpacing regulation. Gateway effects demonstrate that among never-smokers, vaping is associated with an increased likelihood of subsequent smoking. The policy challenge is navigating the tension between preserving harm reduction for adult smokers and protecting youth. Proportionate responses include restricting youth-appealing disposables, strengthening age verification, targeting resources to deprived communities, and equipping clinicians. Continued surveillance and adaptive regulation remain essential.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares no conflicts of interest.

Statement of informed consent

"Informed consent was obtained from all individual participants included in the study."

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