



# Loneliness and E-cigarette Use Among Adolescents in England: Evidence From the Smoking, Drinking and Drug Use Survey 2023

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**Objectives:** Adolescent e-cigarette use is an increasing public health concern in England, yet the psychosocial drivers of this trend remain poorly understood. This study examines the association between loneliness and current e-cigarette use among secondary school students aged 11–15.

**Methods:** We analysed data from 13 725 pupils who participated in the 2023 wave of the nationally representative Smoking, Drinking and Drug Use among Young People in England survey. Loneliness was assessed using a validated composite score derived from 3 indirect questions on social isolation, categorised as low, medium, and high. Current e-cigarette use was defined as self-reported use “sometimes” or “every week.” Logistic regression models estimated crude and adjusted odds ratios (ORs) for the association between loneliness and vaping, adjusting for age, gender, current smoking, ethnicity, family affluence, and alcohol use.

**Results:** Overall, 8.0% of adolescents (n = 1104) reported current e-cigarette use. Compared with those reporting low loneliness, adolescents with medium and high loneliness had significantly greater odds of vaping, with adjusted ORs of 1.48 (95% confidence interval [CI], 1.24 to 1.76;  $p < 0.001$ ) and 2.46 (95% CI, 2.00 to 3.04;  $p < 0.001$ ), respectively. Findings were consistent in sensitivity analyses using weekly e-cigarette use as the outcome. Adolescents with medium and high loneliness had significantly higher adjusted odds of weekly use (adjusted ORs, 1.39; 95% CI, 1.11 to 1.75;  $p = 0.005$ ; and 2.04; 95% CI, 1.55 to 2.71;  $p < 0.001$ , respectively) compared with those reporting low loneliness.

**Conclusions:** Loneliness is a strong and graded correlate of adolescent e-cigarette use.

**Key words:** Loneliness; Adolescent; E-cigarette; Vaping; Social isolation

Received: Jun 17, 2025 Revised: Aug 8, 2025 Accepted: Aug 21, 2025

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## INTRODUCTION

The emergence of e-cigarettes has profoundly altered the landscape of nicotine consumption, particularly among young people [1,2]. Initially promoted as a safer alternative to combustible cigarettes, e-cigarettes were intended to help adult smokers transition away from more harmful forms of nicotine intake [3]. Over time, however, their increasing use among adolescents has drawn significant scrutiny, driven by concerns about nicotine dependence, potential “gateway” effects, and the appeal of flavoured products [4]. While these concerns are

valid, they risk obscuring the broader psychosocial and behavioural contexts in which adolescents decide to use e-cigarettes. For many young people, vaping is not solely about addiction or defiance but can also represent identity, autonomy, and peer engagement [4]. Recognising the diverse and sometimes adaptive reasons adolescents turn to vaping—including curiosity, stress relief, social bonding, and self-regulation—is crucial for developing balanced and effective public health responses.

Among psychosocial influences on adolescent behaviour, loneliness has become a pressing concern [5]. Defined as the subjective experience of feeling socially disconnected or emotionally isolated, loneliness has been linked to adverse mental and physical health outcomes in young people [5]. Adolescence is a developmental stage marked by heightened sensitivity to social dynamics, belonging, and peer approval [6]. During this period, experiences of exclusion or emotional neglect can have especially strong psychological impacts. For adolescents who feel lonely, the desire for acceptance may manifest in behaviours such as using substances that promote social interaction or function as coping strategies [7].

Loneliness is both prevalent and persistent during adolescence. Even before the coronavirus disease 2019 (COVID-19) pandemic, United Kingdom survey data showed that 40% of 16-year-olds to 24-year-olds reported feeling lonely often or very often, a rate higher than that observed in older adults [8]. During the pandemic, these numbers rose sharply: in April/May 2020, more than one-third of young people reported feeling lonely often or most of the time, and nearly 70% of adolescents aged 13–19 said they felt lonely “often” or “sometimes” [8]. These findings demonstrate that loneliness is not a marginal experience but one affecting a substantial proportion of adolescents, with implications for their well-being and risk behaviours.

Despite this conceptual relevance, loneliness has received limited empirical attention in the study of adolescent e-cigarette use. By contrast, prior research has documented links between loneliness and cigarette smoking, suggesting that emotional isolation may encourage nicotine-seeking as a coping mechanism or as a means of social integration [7]. While this evidence centers on combustible tobacco, it provides a conceptual basis for examining similar dynamics with e-cigarettes. Much of the existing literature has focused on external determinants—such as exposure to advertising, peer and parental use, and product availability—without sufficient attention to the internal emotional environments shaping young people’s

behaviour [8,9].

This omission is striking in light of recent evidence showing increases in reported loneliness among adolescents amid global social changes [10], including expanded digital connectivity, shifts in family structures, and disruptions to in-person schooling [8]. By not accounting for loneliness, research risks overlooking a critical factor in explaining why some adolescents are more likely to use e-cigarettes. Likewise, public health interventions that ignore this emotional dimension may fail to connect with young people who are navigating complex internal experiences in addition to external cues.

This study seeks to fill that gap by directly examining the relationship between loneliness and e-cigarette use among adolescents in England. The primary aim is to determine whether self-reported loneliness is associated with increased odds of current e-cigarette use. Specifically, we assess whether adolescents reporting moderate or high levels of loneliness are more likely to use e-cigarettes than their peers with low loneliness. A secondary objective is to estimate predicted probabilities of current e-cigarette use across age groups, to evaluate whether the association between loneliness and vaping intensifies with age during early to mid-adolescence.

## METHODS

### Study Design

This was a cross-sectional study examining the association between loneliness and e-cigarette use among secondary school students in England. Data were drawn from the 2023 wave of the Smoking, Drinking and Drug Use among Young People (SDD) survey, a nationally representative dataset that monitors health behaviours in adolescents aged 11–15 [11]. The survey was administered during regular school hours using self-completion questionnaires and covered a broad range of topics, including smoking, alcohol and drug use, mental health, and peer relationships. The anonymity of the survey and the school-based administration were intended to encourage honest reporting and maximise response rates.

### Data Source and Study Population

The study population comprised pupils in school years 7 to 11 (typically aged 11–15) from 185 schools across England. A 2-stage stratified sampling design was employed, first selecting schools within regions by type and deprivation level, and then selecting 3 mixed-ability classes per school [11]. To

ensure representation across age groups, 2 classes were drawn from years 9–11 and 1 from years 7–8. Surveys were completed online, during school hours, and anonymously. The original dataset included 17 466 participants. After excluding 2964 cases with missing loneliness data and 777 with missing e-cigarette data, the final analytic sample comprised 13 725 adolescents.

## Measures

The primary outcome was current e-cigarette use, defined using responses to the e-cigarette smoking status question (variable: *dcgelec*). Respondents who indicated “sometimes use” or “use every week” (coded as 5 or 6) were classified as current users. Those reporting “never used,” “used once or twice,” or “previously used” (codes 2–4) were classified as non-users. Adolescents who were unaware of e-cigarettes, gave inconsistent responses, or had missing data for this item were excluded.

The primary exposure variable was loneliness, operationalised using the *dloncomp* variable, a composite indicator derived from 3 indirect items capturing emotional and social disconnection. Pupils reported how often they: (1) felt they had no one to talk to, (2) felt left out, and (3) felt alone. Each item was rated on a 3-point scale (1 = “hardly ever or never,” 2 = “some of the time,” 3 = “often”). Scores were summed to create a composite loneliness score ranging from 3 to 9, which was categorised into low (3–4), medium (5–7), and high (8–9) loneliness, reflecting increasing severity of social isolation. This indirect approach is conceptually and psychometrically aligned with the UCLA 3-item Loneliness Scale, which has been validated in adolescent and adult populations [12]. Like the UCLA short form, the items assess core dimensions of loneliness—lacking companionship, feeling excluded, and experiencing isolation—without directly invoking the word “lonely,” thereby reducing social desirability bias. The UCLA 3-item scale demonstrates acceptable to strong internal consistency (Cronbach’s  $\alpha=0.72\text{--}0.89$ ) and predictive validity for a wide range of mental health and behavioural outcomes [12]. By adopting this indirect composite, the study aims to more accurately capture adolescents’ subjective experiences of social disconnection, which may otherwise be under-reported.

Covariates included age (11–15), gender (boy, girl, or other/prefer not to say), ethnicity (White, Mixed, Asian, Black, Other), family affluence (low, medium, high, or missing), current cigarette smoking (yes/no), and past-week alcohol use (categorised by units consumed). Family affluence was measured using a 6-item index covering car ownership, bedroom occupan-

cy, number of family holidays, number of computers, dishwashers, and bathrooms. Responses were summed to produce a Family Affluence Score ranging from 0 to 14. Consistent with international adolescent health surveys, scores were categorised as low (<7), medium (7–10), and high ( $\geq 11$ ), with missing or invalid scores coded separately. These covariates were selected based on prior evidence [1,2,7,8]. Age, gender, and ethnicity are known to influence both substance use and loneliness, while family affluence serves as a proxy for socioeconomic status. Cigarette smoking and alcohol use commonly co-occur with vaping and may represent broader risk behaviour patterns or coping mechanisms related to loneliness.

## Statistical Analysis

Descriptive statistics were calculated to characterise adolescents by e-cigarette use status. Group differences in categorical variables were assessed using the chi-square test.

Binary logistic regression, adjusted for the complex survey design, was used to examine associations between loneliness and current e-cigarette use. The survey design was specified in Stata using the *svyset* command, incorporating primary sampling units, stratification variables, and finite population correction. Logistic regression models were fitted with the *svy:* prefix to obtain robust standard errors and appropriate confidence intervals (CIs). Both crude and adjusted odds ratios (ORs) with 95% CIs were reported. The final adjusted model included age, gender, current smoking, family affluence, ethnicity, and past-week alcohol use. Covariates were selected based on prior evidence linking these factors to both vaping and psychosocial wellbeing. Marginal predicted probabilities of current e-cigarette use were estimated using the *margins* command and visualised with *marginsplot*, stratified by age group to explore potential effect modification.

Two sensitivity analyses were performed. First, the single direct loneliness item (“How often do you feel lonely?”) was substituted for the indirect composite to test robustness to different operationalisations of loneliness. Second, the outcome was redefined as weekly e-cigarette use (excluding those who reported “sometimes” use) to distinguish regular from occasional users. All analyses were conducted in Stata version 18 (StataCorp., College Station, TX, USA).

## Ethics Statement

The SDD survey 2023 was conducted under the ethical standards of National Health Service England and Ipsos United

Kingdom. Participation was voluntary, anonymous, and based on informed consent. Data were collected in de-identified form and stored securely with access restricted to authorised personnel. The study complied with the United Kingdom Data Protection Act 2018 and General Data Protection Regulation (GDPR) of the European Union, with appropriate ethical oversight. Because this analysis used secondary data, no additional ethical approval or consent was required from the authors.

## RESULTS

Among 13 725 respondents, 1104 (8.0%) reported current use of e-cigarettes. Table 1 presents the demographic and behavioural characteristics of adolescents by e-cigarette use status. Among current users, the majority were older adolescents: 41.8% were aged 15 years and 26.1% were aged 14 years, compared to just 2.5% aged 11 years ( $p < 0.001$ ). The gender distribution among users was skewed toward girls, who represent-

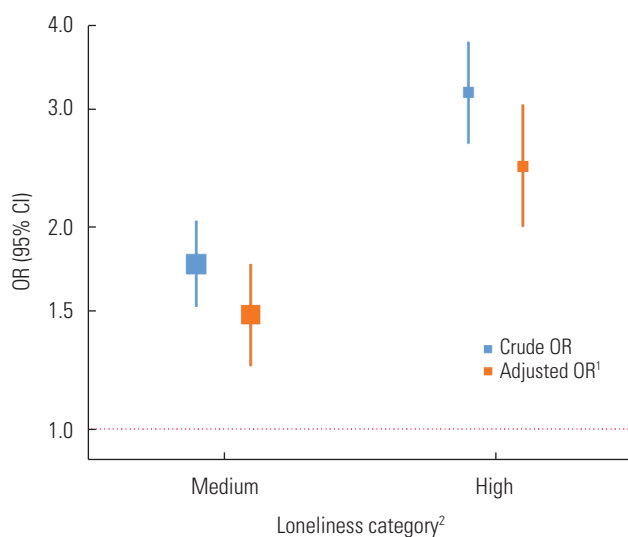
**Table 1.** Characteristics of adolescents by e-cigarette use status

Characteristics	Current e-cigarette users (n=1104)	Non-users (n=12 621)	Total (n=13 725)	p-value
Age (y)				<0.001
11	28 (2.5)	1765 (14.0)	1793 (13.0)	
12	95 (8.6)	3088 (24.5)	3183 (23.2)	
13	232 (21.0)	3208 (25.4)	3440 (25.1)	
14	288 (26.1)	2487 (19.7)	2775 (20.2)	
15	461 (41.8)	2073 (16.4)	2534 (18.5)	
Gender				<0.001
Boy	364 (33.0)	6108 (48.4)	6472 (47.2)	
Girl	659 (59.7)	6044 (47.9)	6703 (48.8)	
Others	81 (7.3)	469 (3.7)	550 (4.0)	
Ethnicity				<0.001
White	845 (76.5)	8323 (66.0)	9168 (66.8)	
Mixed	64 (5.8)	708 (5.6)	772 (5.6)	
Asian	53 (4.8)	1496 (11.9)	1549 (11.3)	
Black	46 (4.2)	932 (7.4)	978 (7.1)	
Other	12 (1.1)	179 (1.4)	191 (1.4)	
Missing	84 (7.6)	983 (7.8)	1067 (7.8)	
Family affluence				0.005
Low	173 (15.7)	1958 (15.5)	2131 (15.5)	
Medium	517 (46.8)	6463 (51.2)	6980 (50.9)	
High	376 (34.1)	3914 (31.0)	4290 (31.3)	
Missing	38 (3.4)	286 (2.3)	324 (2.4)	
Current smoker				<0.001
No	846 (76.6)	12 576 (99.6)	13 422 (97.8)	
Yes	258 (23.4)	45 (0.4)	303 (2.2)	
Past week alcohol use (unit)				<0.001
< 1	773 (70.0)	12 156 (96.3)	12 929 (94.2)	
1–4	68 (6.2)	186 (1.5)	254 (1.9)	
5–9	59 (5.3)	102 (0.8)	161 (1.2)	
≥ 10	161 (14.6)	126 (1.0)	287 (2.1)	
Missing	43 (3.9)	51 (0.4)	94 (0.7)	
Loneliness composite (score)				<0.001
Low loneliness (3–4)	283 (25.7)	5250 (41.6)	5533 (40.3)	
Medium loneliness (5–7)	549 (49.7)	5778 (45.8)	6327 (46.1)	
High loneliness (8–9)	272 (24.6)	1593 (12.6)	1865 (13.6)	

Values are presented as number (%).

ed 59.7% of users, compared with 33.0% boys and 7.3% who identified with another gender identity ( $p < 0.001$ ). Ethnic composition also differed among users: 76.5% identified as White, 5.8% as Mixed, 4.8% as Asian, 4.2% as Black, and 1.1% as Other ( $p < 0.001$ ). In terms of family affluence, 46.8% of current users were from medium-affluence households, 34.1% from high-affluence, and 15.7% from low-affluence backgrounds ( $p = 0.005$ ). Patterns of co-occurring behaviours also varied. Among current e-cigarette users, 23.4% also reported cigarette smoking, compared to 0.4% of non-users ( $p < 0.001$ ). Alcohol use was more common among users: 14.6% reported consuming 10 or more units in the past week, whereas 70.0% consumed less than 1 unit ( $p < 0.001$ ). In terms of loneliness, 49.7% of users reported medium loneliness, 24.6% high loneliness, and 25.7% low loneliness ( $p < 0.001$ ).

Figure 1 visually presents both crude and adjusted ORs, illustrating a clear dose-response relationship between loneliness and e-cigarette use. In unadjusted models, adolescents with medium loneliness had 1.76 times the odds of vaping compared with those with low loneliness (95% CI, 1.52 to 2.04;  $p < 0.001$ ). The odds were even higher for adolescents with high loneliness, with a crude OR of 3.17 (95% CI, 2.66 to 3.77;  $p < 0.001$ ). After adjusting for age, gender, current smoking, family affluence, ethnicity, and alcohol use, the associations



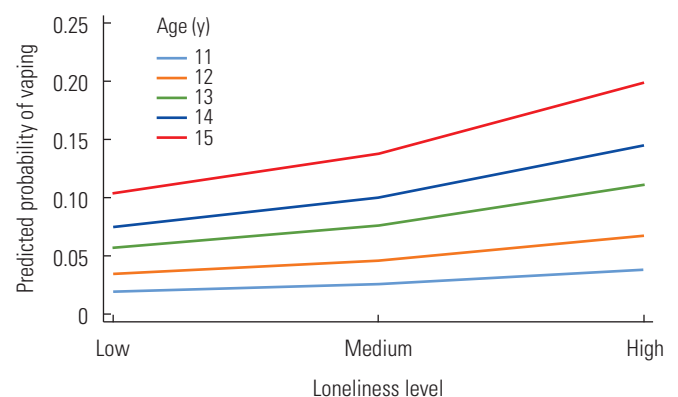
**Figure 1.** Crude and adjusted ORs for any current e-cigarette use by loneliness category. OR, odds ratio; CI, confidence interval. <sup>1</sup>Adjusted ORs controlled for age, gender, current cigarette smoking status, family affluence, ethnicity, and past-week alcohol use. <sup>2</sup>The reference group is adolescents reporting low loneliness.

remained significant: adolescents with medium loneliness had 1.48 times the odds of vaping (95% CI, 1.24 to 1.76;  $p < 0.001$ ), and those with high loneliness had 2.46 times the odds (95% CI, 2.00 to 3.04;  $p < 0.001$ ), relative to peers with low loneliness.

Figure 2 displays the predicted probabilities of current e-cigarette use across age groups and loneliness levels, based on the fully adjusted logistic regression model. Both age and loneliness showed positive associations with vaping probability. At every age, adolescents reporting greater loneliness had higher predicted probabilities of vaping. For example, among 15-year-olds, the predicted probability of vaping increased from 10.3% in those with low loneliness to 19.9% in those with high loneliness. A similar pattern, though at lower absolute levels, was observed among younger adolescents. These results highlight a graded, dose-response association between loneliness and e-cigarette use, particularly pronounced in older adolescents.

### Sensitivity Analyses

Two sensitivity analyses were conducted to assess robustness. First, we repeated the main analysis using the single direct loneliness item (“How often do you feel lonely?”) in place of the composite score. The association between loneliness and current e-cigarette use remained significant (Figure 3). In crude models, adolescents who reported feeling lonely “occasionally or some of the time” had 1.97 times the odds of vaping (95% CI, 1.71 to 2.28;  $p < 0.001$ ), while those reporting feeling lonely “often” had 3.83 times the odds (95% CI, 3.18 to 4.60;  $p < 0.001$ ), compared to those who reported feeling lonely “hardly ever or never.” After adjusting for covariates, the associations were attenuated but remained significant: 1.48

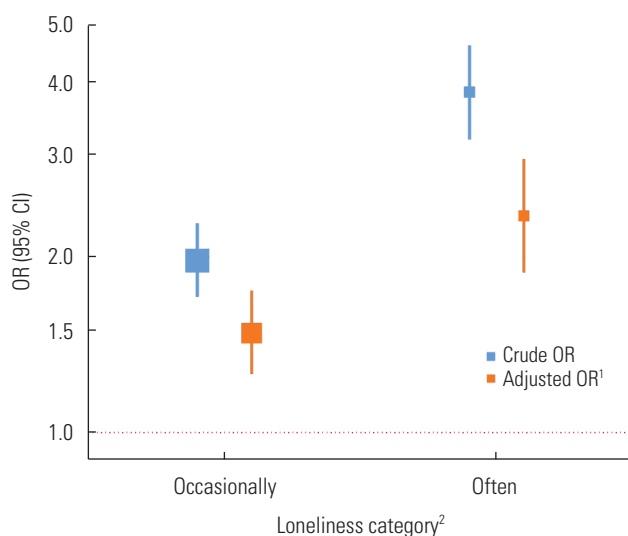


**Figure 2.** Predicted probability of current e-cigarette use by loneliness level and age group.

(95% CI, 1.26 to 1.75;  $p < 0.001$ ) for “occasionally or some of the time” and 2.35 (95% CI, 1.88 to 2.94;  $p < 0.001$ ) for “often.”

Second, we applied a stricter outcome definition by restricting e-cigarette use to adolescents who reported weekly use, thereby distinguishing regular users from occasional ones. As shown in Table 2, the association between loneliness and weekly vaping remained statistically significant. In unadjusted models, medium loneliness was associated with 1.68 times the odds of weekly use (95% CI, 1.38 to 2.04;  $p < 0.001$ ), and high loneliness with 2.92 times the odds (95% CI, 2.32 to 3.67;  $p < 0.001$ ). After adjustment, the ORs were reduced but still significant: 1.39 (95% CI, 1.11 to 1.75;  $p = 0.005$ ) for medium loneliness and 2.04 (95% CI, 1.55 to 2.71;  $p < 0.001$ ) for high loneliness.

Together, these analyses confirm that the observed association between loneliness and e-cigarette use is robust to alternative operationalisations of both exposure and outcome.



**Figure 3.** Crude and adjusted odds of current e-cigarette use by direct loneliness level among adolescents. OR, odds ratio; CI, confidence interval. <sup>1</sup>Adjusted ORs controlled for age, gender, current cigarette smoking status, family affluence, ethnicity, and past-week alcohol use. <sup>2</sup>The reference group is adolescents reporting hardly ever or never.

**Table 2.** Crude and adjusted odds ratios for the association between loneliness and weekly e-cigarette use among adolescents

Loneliness category	Total (n)	Crude	p-value	Adjusted <sup>1</sup>	p-value
Low loneliness (score 3–4)	5533	1.00 (reference)		1.00 (reference)	
Medium loneliness (score 5–7)	6327	1.68 (1.38, 2.04)	<0.001	1.39 (1.11, 1.75)	0.005
High loneliness (score 8–9)	1865	2.92 (2.32, 3.67)	<0.001	2.04 (1.55, 2.71)	<0.001

Values are presented as odds ratio (95% confidence interval).

<sup>1</sup>Adjusted for age, gender, current smoking status, family affluence, ethnicity, and past-week alcohol use.

## DISCUSSION

This study provides evidence of a graded association between loneliness and current e-cigarette use among adolescents in England. Using nationally representative data from more than 13 000 pupils, we found that both moderate and high levels of loneliness were independently associated with greater odds of vaping, even after adjusting for demographic and behavioural covariates. The persistence of these associations in fully adjusted models underscores loneliness as a salient—and potentially modifiable—psychosocial risk factor for adolescent e-cigarette use. These findings are particularly timely given the rising prevalence of both loneliness and vaping in the post-pandemic context. They suggest that emotional and social disconnection may not simply co-occur with substance use, but may also contribute to it. Importantly, the observed dose–response gradient indicates that the likelihood of vaping increases with the severity of loneliness. Although causality cannot be inferred from this cross-sectional design [13,14], the consistency, strength, and gradient of associations provide support for a theoretically grounded relationship. These results highlight the importance of incorporating social and emotional dimensions into youth vaping prevention frameworks.

Prior research on adolescent vaping has largely emphasised external influences such as peer pressure, marketing exposure, and perceived harm reduction, while giving comparatively little attention to intrapersonal and emotional drivers [8,9,15]. By centring loneliness, our study offers a novel and psychologically nuanced perspective on vaping behaviours. The indirect loneliness composite score used in this analysis captures subtle but meaningful deficits in perceived social integration. Adolescents who reported feeling left out, isolated, or lacking companionship were substantially more likely to report current e-cigarette use. These findings converge with theoretical models of self-medication, which propose that individuals turn to substances to cope with aversive emotional states [16].

They also align with emerging neurodevelopmental research suggesting that adolescent brains are highly sensitive to social exclusion and may be primed to seek compensatory rewards [17-19]. Given the central importance of peer connection during adolescence, our findings carry significant implications for both school-based and public health interventions. Programs that strengthen social bonds and reduce isolation may simultaneously promote mental health and reduce substance use [20].

Our results remained robust in sensitivity analyses. First, when the direct single-item loneliness measure (“How often do you feel lonely?”) was substituted for the composite score, the association with current e-cigarette use persisted. Adolescents who reported feeling lonely “often” had more than double the odds of vaping compared to those who “hardly ever or never” felt lonely, even after controlling for demographic and behavioural confounders. This consistency strengthens the construct validity of our results by showing that the association does not depend on how loneliness is operationalised. Second, when the outcome was restricted to weekly vaping, thereby excluding occasional users, the association again remained statistically significant. Although slightly attenuated, the associations still indicated that loneliness predicts more habitual patterns of vaping, which may reflect the onset of nicotine dependence. Taken together, the consistency across both loneliness measures (composite and direct) and both outcome definitions (any use and weekly use) highlights the substantive role of loneliness in adolescent vaping. These results suggest that loneliness is not only a marker of risk but also a potential target for intervention. Strategies that enhance peer integration, promote social connectedness, and foster a sense of belonging within schools may help reduce vaping rates while also supporting broader mental health outcomes [21-23]. Framing such initiatives as having multiple benefits could increase their relevance to both health and education policymakers.

These findings also have direct policy and practice implications. As loneliness emerges as a measurable and modifiable risk factor for youth e-cigarette use, schools and health authorities could consider embedding brief screening tools, such as adapted versions of the UCLA Loneliness Scale, into existing student health surveys. Students identified as experiencing loneliness could then be offered tiered interventions ranging from informal peer-led clubs to structured mentoring programs or counseling referrals. Crucially, these initiatives should be integrated into wider health and wellbeing frameworks to

ensure sustainability. At the institutional level, promoting inclusive and socially cohesive school environments—through teacher training, structural anti-bullying policies, and whole-school engagement—may further mitigate loneliness-driven substance use. Public health surveillance systems could also incorporate loneliness indicators to monitor trends and guide targeted prevention strategies. Rather than treating loneliness and vaping as separate concerns, this study supports a dual-prevention approach that integrates social-emotional well-being with substance use reduction [22].

The age-stratified predictive margins add developmental context to the loneliness–vaping association. While loneliness predicted higher vaping probability across all ages, absolute risk increased sharply from age 13 onward. This pattern likely reflects both normative changes in identity formation and increased access to e-cigarettes. Younger adolescents who reported high loneliness still demonstrated elevated predicted probabilities of vaping, though at lower absolute levels than older adolescents. These age gradients suggest that early adolescence may represent a critical window for upstream interventions focused on emotional well-being [24-26]. Importantly, the predicted margins also demonstrate that adolescents reporting even moderate loneliness—not only those at the highest levels—faced elevated risk. This challenges the assumption that only the most socially excluded youth are vulnerable and instead points to a continuum of social risk, where even modest deficits in belonging can have behavioural consequences. Future research should investigate how shifts in social connectedness over time influence initiation, persistence, and cessation of e-cigarette use. For now, our study provides strong rationale for placing loneliness at the forefront of adolescent health discourse.

The major strength of this study lies in its use of a large, nationally representative sample of adolescents, which enables precise estimation of associations and provides strong external validity. The operationalisation of loneliness through a validated composite measure further strengthens the analysis by avoiding the limitations of single-item indicators. Another methodological advantage is the distinction between current and weekly e-cigarette use, allowing differentiation between habitual and experimental behaviours—an approach often neglected in youth vaping research. The study also benefits from comprehensive adjustment for key covariates, including age, gender, smoking status, affluence, ethnicity, and alcohol use. Nonetheless, several limitations must be acknowledged.

The cross-sectional design precludes causal inference, and reverse causality [27,28], wherein vaping exacerbates social isolation, cannot be ruled out. Self-reported measures are susceptible to recall and social desirability bias, although the anonymous survey setting may have mitigated this. We did not conduct gender-stratified analyses; future work could explore whether the strength or nature of the loneliness–vaping association varies by gender, given evidence of gender-based differences in emotional expression and health behaviours among adolescents. Additionally, although loneliness was the focus of this study, the absence of peer vaping variables in the adjusted models limits our ability to contrast emotional versus social pathways to use. Finally, as with all observational studies, the possibility of residual confounding remains. Despite adjustment for several known covariates, unmeasured factors could partly account for the observed associations. Nevertheless, the findings remain clear: loneliness is a significant and independent predictor of adolescent e-cigarette use.

This study provides evidence that adolescent loneliness is associated with increased odds of vaping in England. The association persisted across crude and adjusted models and remained significant under a stricter outcome definition, reinforcing the reliability of the results. A graded, dose–response relationship was observed, with higher loneliness scores corresponding to substantially greater likelihood of vaping. These results highlight loneliness as a potentially modifiable risk factor warranting attention in both tobacco control and adolescent mental health policy. Interventions designed to strengthen social connectedness and enhance emotional well-being may be pivotal in reducing youth vaping prevalence.

## NOTES

### Data Availability

The dataset used in this study is publicly available from the UK Data Service: <https://ukdataservice.ac.uk/find-data/browse/health/>.

### Conflict of Interest

The authors have no conflicts of interest associated with the material presented in this paper.

### Funding

None.

## Acknowledgements

None.

## Author Contributions

Conceptualization: Adebisi YA. Data curation: Adebisi YA. Formal analysis: Adebisi YA. Funding acquisition: None. Methodology: Adebisi YA. Project administration: Adebisi YA. Visualization: Adebisi YA. Writing – original draft: Adebisi YA. Writing – review & editing: Adebisi YA, Alshahrani NZ, Ogunkola IO.

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